THE

ELECTRICAL REVIEW.

VOL. LV. DECEMBER 9, 1904. No. 1,411.

ELECTRICAL REVIEW.

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THE

UNIVERSAL ELECTRICAL DIRECTORY

1905 Edition

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ELECTRICITY IN WORKSHOPS AND FACTORIES.

THE proposal of the Home Office to enforce certain regulations next year "in respect of the distribution and use of electricity where the normal pressure is greater than 250 volts and less than 650 between any two conductors," has caused quite a flutter among manufacturers and contractors who look upon the proposals as another example of that grandmotherly legislation which, it is contended, has retarded electrical progress in the past. There is, however, a marked difference between restrictions imposed as a result of experience and those based upon a theory of danger unsupported by fact.

It cannot be said that the use of electricity in factories, either for lighting or power purposes, has been greatly hampered by Government restrictions. True, the Board of Trade some years ago issued regulations to be observed in motor installations on supply circuits having a pressure exceeding 250 volts, but as the authority of the Board of Trade does not extend beyond the supply company's terminals, these regulations have been more honoured in the breach than in the observance. The result has been, in the words of the Home Office Circular, "serious, and sometimes fatal accidents to persons employed in places under the Factory Act." How many have been the fatal accidents resulting from the use of electricity is, perhaps, not appreciated by electrical contractors, at whose doors much of the responsibility lies; but the list of inquests attended by the electrical inspector to the Home Office is enough to convince anyone that the existing regulations, whether good or bad, have not had the effect intended.

The Board of Trade regulations, already referred to, apply only to installations fed from public supply systems, and not to those in which electricity is generated on the premises. "The dangers," to quote the Home Office Circular, "in both cases are the same." The dangers resulting from a shock are certainly the same, but it would be scarcely true to say that the risk of shock is the same in an isolated installation as in one fed from public mains. In the one case, so long as the insulation between earth and the conducting portions of the installation remains perfect, no serious shock can be received by touching a single live conductor. In the other case, an earth on any installation fed from the same network makes it immediately possible for a shock to be received on any other installation. The earthing of the middle-wire on three-wire installations, in which the voltage across the outers exceeds 250 volts, limits the "shocking" voltage to half the "outer" pressure, but to earth the negative of a two-wire 500-volt system is, perhaps, a doubtful practice from the point of view of immunity from shock, although it may be defended on other grounds.

Whilst one can understand manufacturers and contractors

viewing with some alarm the enforcing of rules which may make alterations in their standard practice, and, perhaps, add to the cost of installations, the loss of work occasioned, if any, will be infinitesimal compared with the possible harm resulting from a fear on the part of the public that electricity is dangerous, a fear arising from accidents due to bad work. Rules which are aimed at the elimination of bad work should, if properly enforced, be welcomed by all who have the best interests of the industry at heart, and it is to be hoped that the proposed Home Office regulations may be finally so framed as to effect this desirable end. In their present form they have been subjected to a certain amount of criticism, and the Electrical Section of the London Chamber of Commerce have drafted certain modifications which they wish the Home Office to adopt.

In another part of this issue we print an article from the pen of Mr. Frank Broadbent, in which the proposed rules are considered in detail.

In his paper on "Notes on Wiring Rules," read before the Newcastle Section of the Institution, Mr. Broadbent wrote from the point of view of the manufacturer and contractor; his present views as a consulting engineer should be none the less interesting. Quoting from the paper referred to, the author said "the great need that exists is for one definite and comprehensive set of rules—rules which shall be self-luminous, needing no interpreter, rules that the wayfaring man, though a jerry wireman, can understand and work to, and rules, therefore, that may be enforced.'

From his comments on the proposed regulations, we gather that the writer of the above definition considers them to be a step—but only a step—in the right direction.

Rights of Property in Designs and Plans.

The case of Estler Bros. *v.* J. Tylor, Ltd., which is reported elsewhere in this issue, involved the discussion of a question which is of considerable interest to the electrical world. It appears that the plaintiff firm had employed the defendants to manufacture certain castings, fittings, and electrical appliances from designs, consisting of drawings, tracings, photographs, patterns and samples supplied by the plaintiffs. No complaint was made of the way in which the work was done, but it transpired that the defendants made use of the designs, &c., in order to manufacture similar articles on their own behalf. The plaintiffs brought an action in the Chancery Division to restrain them from so doing. The defendants at first contested the matter, alleging (1) that there was a custom of the trade which protected them; (2) that many of the articles in question were of common make in the trade, and that they were, therefore, entitled to manufacture them. Acting, as we think, very properly, they finally consented to an injunction without calling upon the learned judge to decide the question. Whatever may be the terms of the agreement between the parties, it seems to be elementary justice that when a dealer employs a manufacturer to carry designs into execution, that manufacturer ought not to be allowed to make surreptitious use of the designs for his own purposes. The property in and the right to make use of the plans is in their owner. Anyone who makes nefarious use of them can only do so at his peril. While upon this question, we may refer to another problem which sometimes arises with regard to plans.

Suppose an engineer is employed to design a motor-generator or other electrical machine. Assume that he carries out orders, and that the machine is made in accordance with the plans by the manufacturer who employed him. Has the engineer any right to retain the plans as his own? This question has not been expressly decided in relation to engineers, and can only be answered by reference to certain disputes which have arisen between architects and building owners. In a case which was heard many years ago, an architect made a claim for the plans of a house which had been built for the defendant; the architect sought to show that there was a custom of the building trade to the effect that plans remained the property of the architect. This argument was not allowed to prevail, the Court going so far as to say that even if the alleged custom were proved, it was so unreasonable that no effect could be given to it. This decision was followed only a few weeks since by the Lord Chief Justice. It is apprehended that the principle which underlies it would be followed in the case of an engineer laying claim to plans for machinery; and that in the case of the motor-generator above referred to the manufacturer would be entitled to demand the surrender of the plans. From these plans he could make any number of motor-generators if he were so inclined, as they would be his to do what he liked with.

COMPARATIVE DESIGNS FOR A 10-KW. DYNAMO.

By J. W. BURLEIGH.

When designing almost any kind of machinery, present-day competition renders it highly imperative to cut down the cost of manufacturing to the smallest possible amount. Especially is this so in the case of dynamos and motors, and to compete with current prices, and still produce a high-class machine, is a most difficult matter. The designer is usually confronted with points of a very conflicting nature, and at every turn comes the question whether, or not, in a certain design, a little more material would save in labour, or *vice versâ*. In small machines especially is this the case, and with the variety of magnet system shapes one has to choose from, it is by no means an easy matter to select that design which shall be the most economical in construction.

Having occasion recently to make comparative designs for a 10-KW. dynamo, I have gone into the merits of several types, a short description of which I purpose giving in this article. It must be understood, however, that I do not claim the data given to be of a very high degree of accuracy, but I believe they are worked out quite carefully enough for the purpose of comparison.

Design A represents what is known as the Manchester type.
" B, the ordinary horse-shoe type, with bed-plate combined.
" C, ordinary four-pole type.
" D, a type more or less the writer's.
" E, the patented form of the Zone Dynamo Co., lately described in the Review.

The desired output was 110 volts 90 amperes at 1,000 revs. The following data apply to the designs illustrated:—

	A.	B.	C.	D.	E.
Diameter of armature ...	10 in.	10 in.	10 in.	10 in.	10 in.
Length of armature ...	6¼ in.	6¼ in.	6¼ in.	6¼ in.	6¼ in.
No. of slots	60	60	61	60	60
Conductors per slot ...	4	4	4	4	4
Total No. of conductors	240	240	244	240	240
Area of arm	31·3	31·3	15·7×2	31·3	31·3
Area of magnets ...	20·8	38·3	18·7	39·87	34·3
Area of yoke	21	38·3	18·5	36	32·5
Ampere turns per pole	2,760	2,760	1,400	2,760	2,760

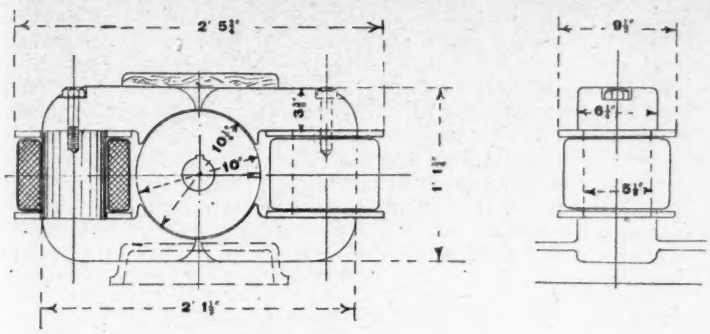
Material in magnet system. Cast-steel in each design.

Cost in Shillings of Magnet System and Field Copper.

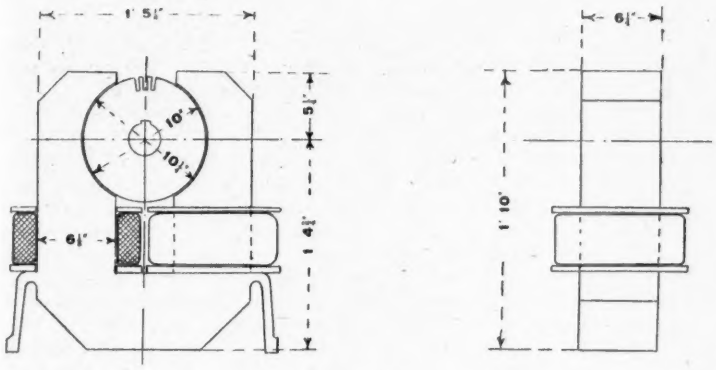
	A.	B.	C.	D.	E.
Cost of steel ...	74	85·4	65·6	95	54·8
Cost of copper ...	52·6	41·6	59	41·6	33·3
Total ...	126·6	127	124·6	136·6	88·1

It will be seen that the armature is the same for each design with the exception of the four-pole machine, in which case it was necessary to introduce an extra slot to render it suitable for a series-wound armature.

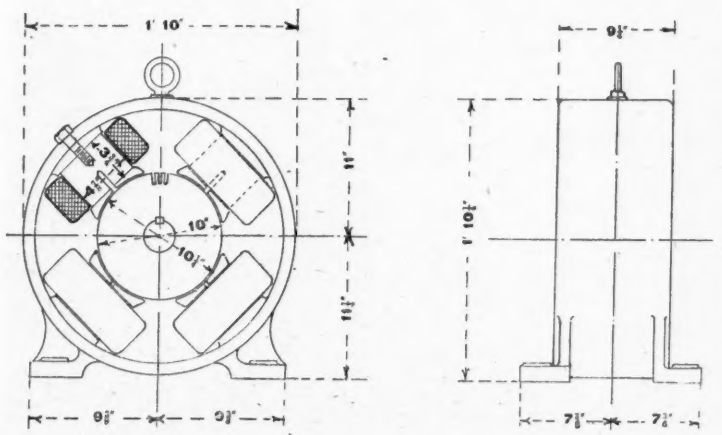
The embedded length per turn for the two-pole machines is 11·25 in., and the free length 38·25. Turns per section = 2; diameter of commutator, 6 in.; width of brush, ¾ in.; three sections would be short-circuited, therefore the inductance



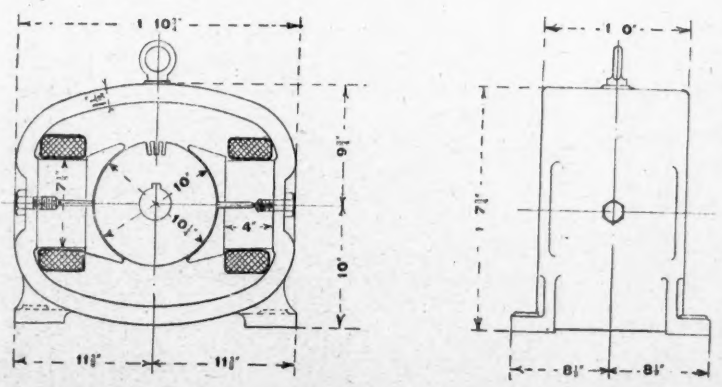
Design A.



Design B.



Design C.



Design D.

of the coils undergoing commutation would be ·0000376 hy.; frequency of commutation = 210; current per conductor = 46 amperes; reactance volts = ·0000376 × 2 × × 210 × 46 = 2·28 volts.

In choosing a type for small sizes, it is of the greatest importance that the design of magnet system should adapt itself for either an open, semi-enclosed, or fully enclosed machine. Design A lends itself very well for an open type dynamo or motor, but is not at all suitable for an enclosed type. This remark also applies to design B. From the table of cost of material, it will be seen that they are practically equal. The total cost, however, would be in favour of B, owing to the entire absence of joints, whilst from a commutating standpoint, A would have the advantage owing to a more even field in gap. Designs C, D and E are all adaptable for open or absolutely enclosed machines; therefore, it would be advisable to select one of these types in preference to the two foregoing. The four-pole shape would work out comparatively expensive in labour cost, although it costs less for material than design D. The total cost, however, would compare very favourably, and it is quite likely, when everything is considered, that it would be cheaper than the four-pole. Design D, too, presents a very pleasing appearance, which is also a point to be considered.

Design E (see page 932) represents a novel and very inexpensive type of field magnet, and is far in advance of the other types I have taken for comparison. It makes an extremely compact machine, and, owing to the very little machining required, and the fact that it requires much less material, it is doubtless the cheapest construction in the market. It has excellent commutating properties, due chiefly, I presume, to the position occupied by the exciting coil. I recently tested several machines of this type, built by Messrs. Newtons, Ltd., of Taunton, and found they were capable of standing considerable overloads with an entire absence of sparking. In these machines the magnet frame was entirely of cast-iron, and I understand that Messrs. Newton build machines up to 200 H.P., using cast-iron magnets throughout, and yet, owing to the great saving of material, the weight compares very well with those of other makers using cast-steel magnets. I am particularly interested in this type of dynamo, as by its improved commutating properties, I believe its advent means another "chip" off the carbon brush, of the abandonment of which I feel sure, as I explained in an article in the Review dated June 10th, 1904.

Comparisons similar to those I have taken, present an interesting study to the designing engineer, and although it takes considerable time to make a set of preliminary designs as embodied in this article, I am convinced one is amply repaid by the results so obtained.

Electric Traction and Snow.—It is interesting to mention that throughout the recent heavy fall of snow, the electrified train service on the North-Eastern Railway Co.'s suburban lines at Newcastle was maintained in full operation without any interruption or the slightest difficulty of any kind, although on many of the steam lines considerable delay was occasioned.

D

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week.

The Cult of the Marine Engineer.

What is the object of this baby discussion between marine and land infants? There is a certain class of man who has served his five years or so in the engine and boiler shops, been through such technical colleges as Finsbury, Faraday House, &c., and has then started in the central station right at the bottom of the *staff* ladder. This man is called a central station engineer, and, if he does his work, will go right to the top. The *usual* (I do not say *only*) position of the marine engineer in a central station is that of fitter or foreman fitter, and he gets from 35s. to 60s. per week. He is, as a rule, a first-class fitter, and a good man with engines and boilers in every way. In this station we employ a fitter of middle age, who not only has a chief certificate, but who has sailed many years as chief; he earns 40s. a week. Our shift engineers, on the other hand (all young), get from 30s. to 38s. Nevertheless, as members of the staff, they are over the fitter, and justly so. They have all served in the shops, can indicate and work out cards, set valves, test coal and flue gases, control steam tests, &c. They can also use a file, &c., and machine tools, fit bearings, and, in short, take the fitter's place. In addition to this, they have served their year or so in electrical shops, and have been students of well-known training colleges. All round central-station engineers are worth (in a station) 20 men with chief's certificates, for they can (in the absence of the mains super.) look after and find faults on the mains, test meters, make out cost sheets, estimate, &c. They will all make good chief assistants and chiefs in due course. Now, what would our marine engineer do—

1. In the test room, with meters, lamps, arc lamps, potentiometers, post office boxes, photometers, &c.?

2. With a bad fault on the mains (somewhere) on a pitch dark night?

3. When testing our dynamos and alternators?

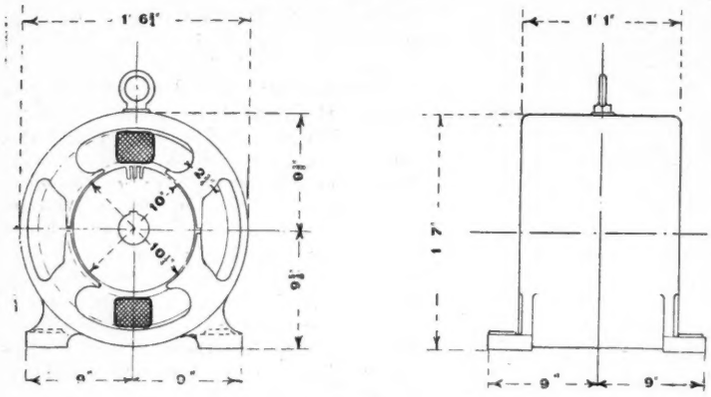
4. On the switchboard evening run, and especially during a complicated electrical breakdown inside or outside the station?

What would a bull do in a china shop? Our marine engineer—excellent fellow though he be—has lots to learn before he can compete with men like the shift engineer in this station, and if he comes into the station to *learn*, it is against the interest of the station, to say the least of it. It may be asked why the marine engineer (as fitter) earns more than the young central station engineers, who are both mechanical and electrical. It is simply because they *are* young and not long out of their time. The fitter has reached his climax in *nearly* every case and is not a youth. The switchboard men and charge engineers are embryo chief assistants and station chiefs, and are going through the mill at half the salary they are worth, because they know that they will *suddenly* jump from £150 to £400 per annum. The average marine man can never hope to compete against this class of man for the highest posts in electricity works. Throughout the stations of the United Kingdom how many marine engineers hold the position of chief, chief assistant and mains super.? Are there two? If so, these two went from their ship to a training college. In conclusion, how can this matter be discussed? Central station engineers are divided into four grades:—Extra smart, smart, stupid but plodding, extra stupid but loves his work.

Marine are divided into four grades:—Extra smart, smart, stupid but plodding, extra stupid but loves his work.

The first two in each case will come right to the top *in their respective callings*, the third will "get on," and the fourth will surprise people by "doing well." Then there are the usual "arrant wasters" of both classes; these are generally extra stupid and don't like their work or any other work, and need not concern us, as we can all spot them in a day. This is, therefore, not a matter which can be discussed, it depends so much on the individual. At least one little office boy has risen up in our midst to become one of the greatest central station authorities in the United Kingdom. An extra smart man, given good health and life, will *always* come to the very top in whatever work he takes up, and whatever his training and opportunities.

No Name.



Comparative Designs for a 10-kw. Dynamo.—Design E. (See p. 931.)

In the correspondence now proceeding in your valuable paper, *re* marine engineer *versus* the purely electrically-trained man for central station work, I beg to throw in my weight in favour of the former.

Both the naval and mercantile engineer have too long been depreciated in their respective capacities, viz., on board ship, but it is now gratifying to learn that the responsible authorities are beginning to realise their true position and their indispensable value in regard to other departments. The several causes of this non-recognition I shall not enter into here.

The above illustrates your first correspondent's letter on the present topic, as if he were more thoroughly acquainted with the composition of the marine engineer, he could not hold the opinion he does now, but, of course, he himself says his letter has not been written impartially.

To begin with, the marine man goes through a *bonâ fide* apprenticeship of four, five, or six years, and his sea experience includes many various types of engines and their auxiliaries, and in many cases electrical apparatus, while he has to do repairs, large and small, against time and very frequently has to make the tools to do the work with. The subjects which his examinations force him to know, (which, by the way, include electrical subjects and hydraulics), impart to him such a practical and theoretical mechanical training as to fit him thoroughly for the duties involved in a generating station (especially if he has not wasted his opportunities for improving himself in the various engineering branches). He enters the works with his eyes, ears, nose and hands trained in the general oversight of mixed running plant, and is equipped with that sense one may call intuition, which sees things at a glance, and is but the outcome of his previous training; he also has that grand insight into human nature gained by handling various types of men, not of the best, generally.

A man thus trained can much more readily acquire the electrical part, than can one, with electrical training only, acquire steam practice.

Compare the marine or mechanical man with a shift engineer, or even a manager of an electric station, who first commenced as a switchboard attendant, rose from that to shift engineer, and then to manager without any previous mechanical training; there are many such men in positions up and down the country. Why, we see not a few instances in large industries, where they take men from sweeping the floor to do wiring, &c.; these very men bloom afterwards as electricians.

Prof. Garnet said, in one of his lectures I was attend-

ing about five years ago, that to be a useful and successful electrician, one should first be impregnated with a practical mechanical training in steam practice.

I now leave this question to the judgement of impartial competent men, regarding the value of the two men above described.

Equity.

I have read with much interest the various letters in the ELECTRICAL REVIEW, and think—other readers, I've no doubt, will agree with me—that "Kia Ora" has drifted from the original subject; not only that, but he is a very poor specimen of a diplomat. In his opening remarks, he does not desire—with his way of it, to raise ill-feeling amongst engineers, but that is just exactly what he tries to do before he finishes up. In my opinion, the gist of his whole letter is spleen, and he cannot hide it.

When the first letters appeared in your issues under this head, I read them closely, and formed the opinion that they applied to men in important positions in the management of central stations, but your correspondent "Kia Ora" drifts into the question of the charge hand, &c., who are only units in the undertaking, though certainly above the ordinary marine engineer in that they have charge.

Apart from this letter, however, my own opinion of the whole question is, that the man to fill the position of whole management is one who has served his apprenticeship in (1) mechanical, and (2) electrical engineering. Then, and then only, has he the knowledge to know that all matters are being worked on proper lines, also that all sorts of faults can be located in both branches. How can a marine engineer be supposed to know all the varied causes anent electrical breakdowns that take place at very awkward places and times? Electricity is not like steam—it cannot be seen to be located; more than this, he cannot know how and when his electrical assistants are taking care of the plant under their charge, keeping and saving the machines from undue work or overloading. The same thing applies to the mechanical side. Then what about his accumulator work, which at all times has to be carefully attended to, not to speak of laying extra plant from time to time, outside feeders, junction boxes, consumers' various complaints, &c.?

In conclusion, I can only add what I said before—viz., the man to fill the position of a central station plant and management must be a man who has a practical knowledge of mechanics, and has had, say, 7 to 10 years' experience of electrical undertakings of, say, constructing switchboards, building dynamos, laying cables, testing instruments, and general electrical working.

Stephen M. Johnstone.

December, 1904.

If you could spare the space in the ELECTRICAL REVIEW for a letter from an electrical man on the question of electrical or mechanical (marine) engineers-in-charge of an electricity works, perhaps it would cheer up some of the downhearted technical college men, and others of that ilk.

If the disappointed electrical man when he finds that a mechanical man has been put in charge of a station, will compare his age with that of the marine man, he will probably find that he is several years younger.

The youngest marine engineer-in charge I have known was 26 years old when appointed, and the majority of them are between 30 and 40.

One or two more years' extra age, not experience, are rather important during the early twenties, when the question is one of having charge of men.

I think most electrical men with a proper training have got twice as good, or better, jobs than that of engineer-in-charge in the majority of stations by the time they are 26 or 27 years of age.

Most of the grumblers on the electrical side are men between 20 and 23, who have just come from their first place after leaving the technical college. They think they are better men than the marine man; probably they are in some things, but they have not proved it to their chiefs. My experience is that there are usually assistants' places, at a fairly satisfactory salary, when the chief is satisfied that the man is suitable.

Perhaps a hint might be taken in good part by some of them—namely, do not grumble amongst yourselves about the unfairness of it; it only makes you rather a misery to yourselves, and a nuisance to other people. Make friends with the marine men; they will usually meet you half-way, and both sides then have better opinions of each other.

Balderstone, A.I.E.E.

One would think, after perusing the correspondence in your columns on this subject, that there are only two classes of engineers to be found in central stations, viz.:—The man who has been to sea, but would be ashamed to know anything of electricity, and the Finsbury-Brush Co. young man (as one correspondent describes him) who walks about in a white shirt, too proud to dirty his hands. Are either of these competent to take charge of an electric power station?

It is a peculiar thing, but I have frequently noticed that the purely mechanical engineer at once becomes suspicious of a man who understands the principle and management of electrical apparatus.

Some men have even gained reputations for being good mechanical engineers because of their ignorance of electrical work.

Most of your readers will remember the well-known case (reported in your columns some time ago) of a Lancashire borough which appointed its engineer on these grounds.

On the other hand, the electrical man scorns "experience"; he studies the principle of the steam engine, and, after he has seen it run round for a few months, considers himself quite competent to manage it.

All the qualities claimed for the marine man and the electrical man may be admitted—each in his own situation is admirable; but each becomes absurd when attempting to interfere with the part which he does not properly understand.

There is a third type of engineer to be met in central stations, who has spent years in mechanical training, either at sea or on land (or both) and then by hard work has added years of electrical experience. Where central stations are run with success, it is to this type of engineer that the credit belongs.

In spite of all that the marine engineers may say, it is not in the least necessary to go to sea in order to learn how to build, manage and repair land engines, land boilers and all the mass of auxiliary machinery to be found in a large modern power house.

It would be just as reasonable to say that a man must on no account go to sea but must remain ashore, if he is to become a marine engineer.

I have seen sea-going and land mechanical engineers in charge of central stations with assistants to "operate the switches." I have also seen electrical engineers with assistants to manage the engines and boilers. I don't know which is the more out of place, but certainly the former is the more dangerous in a high-tension station. It is obviously easier to become proficient in one branch than in two, requiring less work and less expense, but still there are engineers properly trained for central station work, though probably not so many as are needed.

Station Engineer.

Trouble with Pitch Grouting on Tramways.

In your leading article on permanent way construction in the issue of December 2nd, you raise the question of pitch grouting for the paving round tramway track.

On one route in this town we have had considerable trouble from this cause during the last few summers. The route in question has a grade of about 1 in 20, and close to every joint in the rail, pitch oozed up continually, and covered the tread of the rail, causing a lot of arcing on the up track, and on the down track, what was considerably worse, bad slipping of the brake blocks on the wheels, due to pitch getting on them, and becoming very oily from the friction heat. In fact, on one occasion we nearly had a runaway from this cause.

I have said that the pitch oozed up close to every joint in the rail, and it was observed that it was always about 12 in. on the up side of the joint. The explanation I arrived at,

was that between the granite setts and the web of the rail there was a space forming a channel about 6 in. high × 1 in. broad, and the pitch collected there and ran down it until it met an obstruction in the shape of the fish-plate, which it could not pass, and therefore accumulated, and was forced up through the crevices by the weight of the pitch coming down behind it.

For two or three seasons the only remedy applied was keeping a gang of men scraping the head of the rail, and using the track water-cart to cool it, and this, of course, was a big expense.

Last summer I adopted a plan which, no doubt, could only be tried on a country route such as the one in question, namely, burning the pitch out. On each side of every joint I took out the setts for the length of the fish-plate. I then got some oily waste and some creosote oil, and spread them round about the rail for a distance of about 9 or 10 ft. on the up side of the opened-out hole, and set them alight. The pitch was melted out and ran down alongside the web of the rail, and accumulated in the hole at the joint from which the few setts had been removed, and was then ladled out, two buckets-full being got from most of the holes. In this way the joints between the setts were cleared of the pitch for a length of about 10 ft. and about 18 in. on either side of the rail. After cooling the few setts were put back round the joint and the whole made good with cement grouting. A gang of six men could do about 20 joints per day.

Lionel E. Harvey.

Sunderland, *December 6th*, 1904.

Technical Education for Workmen.

Much has been said of late upon this subject, and the prevailing idea is that working men have not opportunities offered them, whereby they may improve themselves and better their positions. From the point of view of a man who has had experience in technical school, college and workshops, perhaps a few lines will be of benefit if they only succeed in eliciting criticism from those who uphold the above idea. One can say with truth that education, and that of the best kind, is cheaper to-day than ever before.

There is scarcely a town of size in England which does not offer facilities to those who wish to learn, such as would satisfy the demands of the most extreme. No doubt there are many villages where such facilities are inaccessible, but the demands and wants of such villagers are few, and were they given the chances which those in the town have, we can only judge what the results would be by the results we get in the towns.

Education is too cheap to-day. We all value what we have to pay and work for more than that which we obtain easily, no matter what their relative values may be. It is the old story over and over again—man excusing his failings and want of ambition under the saying, "If I only had the chance of so and so, wouldn't I get on, and wouldn't I do different from what he is doing," and all the time he is wasting chances which are thrown at him.

Because he cannot get a three years' day-course at a college is no reason why he should throw a night-course away. And supposing he did get a three years' day-course, he would probably envy the lot of the gentlemen's sons who can afford to waste their time, and ruin his own chances by an attempt to imitate their example. My contention is that working-men do not take advantage of the opportunities offered them. I know one town where 100 free scholarships were offered for a one year's course in any of the trades, to be extended to three years if attendance, &c., were satisfactory. Only 37 of these were asked for, and this was in the West Riding of Yorkshire, where people are so go-ahead and enthusiastic about education.

Go to any technical school you may choose and you will have the same story told you—"Lack of interest in work, bad attendance and poor results." Of course there are exceptions; but I am speaking of the general state of things, and not of individuals.

Leaving out of consideration the great majority, who say they are too old to start these things now, or excuse themselves and their consciences by saying it will do them no good, let us examine those who do start going to night classes. At first the class is crowded; at the end of the first term the attendance has dropped to 65 per cent., while at the end of the second term we may, if we are lucky, get a percentage attendance of 45 to 50 of those who first joined the classes.

Now for the reasons of this falling off. The students often blame the teachers, who, in their turn, do not worry their heads, but take it as a matter of course; they have seen this kind of thing too often. I have seen accounts in your paper of men who have attended classes four nights per week, and not been any the worse for it. It would do some of these men good to work for eight or ten hours per day in a hot engine room, and then crawl wearily home to tea, or perhaps get a snack at works before proceeding to such classes. They would soon weary of it, I dare prophesy. "Change of work is rest," we know; but work is work, no matter of what kind, and sleep and ease are the only perfect rest to a tired man.

Even if one could attend four nights per week, what good is it? The propounders of this time-table know as well or better than I that little is learnt at classes and lectures. The time is fully occupied in taking notes without digesting them. When are these men going to do the private study necessary for success? At work there is seldom any time in which to do it, and there are practically no nights left in which to do it at home. At week ends a will of no common strength is required to keep a man, who is working inside all the week, at his books, even if there were no other social or home demands to attend to.

Again, before half the session is over, the teacher is far over the heads of the majority of the students, and their interest naturally falls off completely, and we hear: "He goes too fast; he knows a lot, but he cannot teach it," &c.

How much the teacher would do, if he went at the speed demanded by some, one dare not guess. This fault is both with the students and teachers. The students don't know what they do know, and have little or no idea of what is contained in the course they are taking, whilst the teacher does not trouble enough about the previous knowledge of his students. It certainly seems sensible to take a first year's course in electricity to an electrician, but he does not know the arithmetic involved and the simple mathematics demanded. Hence, he is often at sea, and yet it is only elementary electricity he is taking. How many workmen know what $C = \frac{E}{R}$ really means? It is easy for us, who have been amongst symbols from our early schooldays, and had algebra and mathematics drilled into us, to understand this; but to one who had to leave the elementary school at the age of 14 years, or younger, it is a mountain to climb. No wonder he loses courage, and gives up the task.

It is often easy to find the fault in a system, but hard to remedy it. Be sure your classes are elementary enough; ask the lecturer what he thinks is best for you, and try his advice. One class per week well followed up at home is better far than four per week with a weary head and body and no results. Everyone knows best how much he can stand, and no one can lay down rules for the health of another where study is concerned.

In conclusion, let me tell the few honest and hard workers that it will take them much longer than the more favoured day students to obtain the same amount of knowledge. It is only the minority who have the chances of these, but what the night student can do is to rise above the ordinary or contented level, and see at least a little result from his labours; for labour it is after working what others call a day's work, to go to an evening school for one or more nights per week.

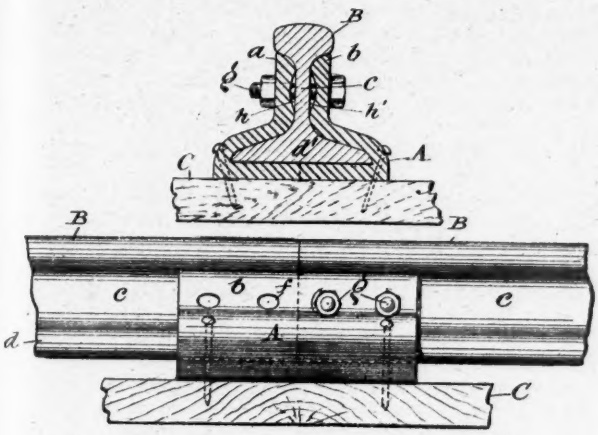
W. S.

Rail Joints.

With reference to the article in last week's Review on this subject, I should like to call attention to a fishplate I patented some time ago. This fishplate, as the sketch shows, is a solid casting, made so that it slides on over the ends of the rails, and so formed, that when bolted up, a perfectly rigid and solid joint is the result.

The fishplate has been in use both on the level and on

steep gradients in South Wales for about nine years, and has had to stand the rough usage of a busy mineral line, but it has proved so good a job, that not one single bolt has had to be tightened up since first put down, and the rail-ends are in just as perfect line as in newly done work.



If this fishplate were used on tramway work, I have no hesitation—after this and other severe tests—in saying that such things as bad joints and the resulting damage to rolling stock would be practically unknown. Of course this joint would require bonding, but taking everything into account, the cost per joint would be far less than the only other way of making a good joint; viz.:—welding.

I think I may claim that the foregoing is not merely an inventor's view, but a sound practical way of getting over a considerable difficulty in tramway work.

George Ashford.

Newport, Mon., *November 29th*, 1904.

Corrugations in Rails.

I think "X" will find the probable explanation of this phenomenon in a paper entitled "Roaring Rails," by H. L. Wilkinson, resident engineer, Bengal and North-Western Railway Co., which singularly appears in current issue of the *Engineer*, p. 538.

F. E. Rebbeck.

Belfast, *December 5th*, 1904.

Nernst Lamps.

I am glad somebody has set the ball rolling with regard to Nernst lamps as a commercial success. I was amongst the first to take them up and hoped they had come to stay, but up to the present the results are not at all promising, mainly on account of burner troubles.

In answer to "Gloucester's" questions:—

1. The new type burner I consider a fatal mistake, and one that must be remedied at once. Not only has my experience shown me a shorter life, but there is a considerable tendency to short circuit when the lamps do not hang vertically.

2. I have made careful tests of both, and my opinion is that if lamps are only removed to change burners, polarity may be ignored.

3. Not under present conditions, where faulty burners that give out after a life of only a few hours, have to go against those that do show a passable economy. In addition to this numerous repairs are necessitated, which in themselves form a considerable item against the universal adoption of these lamps.

R. A. P.

Referring to "Gloucester's" letter *re* above, I have much pleasure in giving him the following regarding his questions:—The Nernst ½-ampere "A" type lamp has most undoubtedly given the most satisfactory results on our voltage, viz., 250. I find that the most satisfactory results are got from a 30-volt resistance with a 240-volt burner on 250 volts, but if a 20-volt resistance with a 230 or 240-volt burner on 250 volts be used, it would ruin any contractor to try and maintain the lamp.

I consider the ¼-ampere lamps give more trouble than the light is worth, and it is long since I gave up retailing them here.

Polarity makes very little difference on the lamps so long as one can be sure of the E.M.F. being kept at constant pressure, but if such rises and falls, which it does in most corporation supplies, then it stands to reason that the resistance must be acted on first so that it may take up the over-plus of voltage likely to injure the burner.

As a contractor in Glasgow, I have a very large number of customers using the Nernst lamps; a large number of them stand by the lamps as a saver of money, others have put them out. I consider the ½-ampere lamp to be a saver of money if used as I have already put forward; the 1-ampere lamp I do not consider at all satisfactory. This letter applies to both types of burner "A" and "B" in both sizes of lamps.

Nehpets.

Electricity in Cotton Mills.

With regard to the article on "Electricity in Cotton Mills" in your last issue, we believe the following may be of some interest.

Quite recently tests have been carried out on spinning frames driven by our special "unit system," where each frame is driven by a separate motor, and the following is an extract of the results obtained:—

The frames were designed for a variation of speed of spindle from 6,000 to 9,000 r.p.m. to suit the different counts being spun. The following are the outputs required for different speeds:—

Revolutions of spindle.	Revolutions of tin roller.	B.H.P.
5,200	514	·55
6,200	612	·7
6,600	652	·75
7,100	680	·77
8,100	768	·85
9,200	880	1

It will be seen that the power taken increases practically directly as the speed, and not, as has been generally accepted, as the square of the speed.

Tests were then carried out on frames driven in the ordinary way by means of belts from the countershaft, and the following results were obtained:—When the countershaft was running without the straps which drive the frame, the power taken was ·48 H.P. When the straps were put on, and running on the loose pulleys, the power increased to 2·13 H.P.

This is about the power required to drive three frames of 62 spindles at about 5,200 revs. by the direct-driven "unit system." This, we think, is a surprising result, and shows the great loss of power which is taking place in our mills through belt driving, which amounts to about 50 per cent. of the total power.

These results, supplementing the figures given in the above-named article, prove the great advantage derived from using electric power in cotton mills.

The Alliance Electrical Co., Ltd.,
Arthur Bloemendal, *Manager*.

London, W., *December 2nd*, 1904.

Arc Lamp Hoisting Gear.

I should esteem it a favour if I could be supplied, through the medium of your valuable columns, with information with regard to the most suitable apparatus for the raising and lowering of street arc lamps.

Hoisting.

[We may refer our correspondent to the article on pp. 444-445 of our issue of September 16th, and other recent issues of the Electrical Review.—Eds. E.R.]

Contractors v. Supply Companies.

I notice in your issue of the 2nd inst. a letter from Messrs. W. K. Partington & Co. complaining that my company's action in issuing a circular offering to test and examine consumers' fittings is calculated to injure the interests of contractors.

My object in writing you is to correct the misconception of the firm in question. My company has always endeavoured to maintain a strictly impartial attitude towards all contractors and to avoid interfering with their legitimate business.

My company's circular is really to the advantage of contractors, because if, on inspection, defective lamps or fittings be discovered, it is left to the consumer to call in his own contractor to repair or replace them. Without my company's circular it would probably never occur to the consumer to have his fittings and lamps inspected.

As regards lamps, my company simply recommends that the consumer should use lamps of British manufacture of the best makes. It does not offer to supply them, and in effect refuses to do so.

For your information I enclose a copy of the circular and of the form of report which is issued to the consumer after an inspection has been made.

J. Cecil Bull.
Manager and Secretary,
City of London Electric Lighting Co.

London, E.C., *December 2nd*, 1904.

Electricity Control.

I have recently read with both pleasure and profit the new work just published under the above title.

There is one statement made on page 122 to which I take exception, namely :—"It is necessary to ascertain that the incoming generator is running at exactly the same *speed* as the working generator before two alternators can be connected in parallel."

I think it is obvious that this can only be applied to identical machines, and cannot be used as a general condition, because the *speed* of a generator varies according to its type and size, and it is quite a common thing for two or three alternators to be "in parallel," and yet with speeds ranging from 350 to 3,000 r.p.m.

I have no doubt that the author will agree with me that the word "frequency" should be used instead of "speed."

Harry Webber,
Chief Assistant, Hastings.

December 6th, 1904.

Working of Battery.

May I ask, through the medium of your "Correspondence" columns, whether Chloride batteries require strengthening with sulphuric acid? If so, how often, and of what specific gravity should the acid be?

The batteries in question evaporate about a quart of water per cell per week, owing to their being situated over a boiler house, and they also require charging daily. They have been in constant use for about two years and nine months, and during the whole of this time only distilled water has been added to them.

The batteries are of the Chloride Electrical Storage make, 56 cells, each cell containing 15 plates of the "R" type.

Batteries.

[A correspondent points out with regard to our note in this column on November 11th, *re* the exemption of 250-volt three-wire systems with earthed neutral from the operation of the Home Office regulations, that every installation with more than 250 volts *between any two conductors* comes under the regulations as drafted.—Eds. Elec. Rev.]

Gas Exhibition.—At this exhibition at Earl's Court Messrs. Meldrum Bros. at Stand No. 40 Queen's Palace Annexe, show their patent breeze furnaces of standard type, and of improved low-grade type, also their retort scurfer.

DINNER OF THE INSTITUTION OF ELECTRICAL ENGINEERS.

The sixteenth annual dinner of the Institution of Electrical Engineers was held on Thursday, 1st inst., at the Hotel Cecil, Mr. Alex. Siemens, the president, being in the chair. The accommodation of the King's Hall was taxed to the utmost, a number of applications for seats having to be refused, and there were present about 440 members and guests. The official guests of the Institution numbered 100, and included many distinguished representatives of the Bench and Bar, of the other learned and scientific professions, of commerce and of industry.

After the loyal toasts had been duly honoured at the invitation of the president, the Right Hon. Lord Alverstone, Lord Chief Justice of England, proposed "The Institution of Electrical Engineers." Lord Alverstone recalled a previous occasion when he was the guest of the Institution, which he regarded as one of the most successful of scientific societies, thanks to its progressive character and scientific methods. After briefly reviewing the progress of electrical science during the 33 years of the existence of the Institution, he referred to the recent honours conferred upon two of its members, Sir W. Crookes and Sir J. W. Swan, than whom no man was ever more worthy of distinction. He coupled with the toast the name of Mr. Alexander Siemens, who had been re-elected not merely for his kindly and charming disposition, but also because of the distinguished name which he bore, Sir William Siemens having been one of the founders of the Institution.

Mr. Siemens, in his reply, drew attention also to the honour conferred upon Lord Kelvin by his installation as Chancellor of Glasgow University. He read telegrams of goodwill from the Belgian and Italian Electrical Associations, and referred to the international character of electrical engineering, and to the visits of the Institution to foreign countries, which had shown us what was being done abroad. He was grateful to his uncle for the lustre which he had shed on the name of Siemens.

Mr. R. Kaye Gray then proposed the toast of "Our Trans-Atlantic Kinsmen," eulogising the distinguished public services and open-handed benevolence of Lord Strathcona, High Commissioner for Canada, and referring to the career in the Diplomatic service of the United States of Mr. W. I. Buchanan, managing director of the British Westinghouse Co. The work which was being done in the newer hemisphere was such as the world had never seen; but having regard to the origin of their trans-Atlantic kinsmen, who were the immediate descendants of all that was young and healthy in the old country, unhampered by the conditions of society obtaining in crowded communities, and equipped with the best traditions and qualities characteristic of the Anglo-Saxon race, with an enormous field to work in, it was not astonishing that the United States and Canada occupied the position in which they stood that day. Their kinsmen had the faults of their merits; their optimism was admirably adapted to overcome difficulties, but the time must come—sooner in the United States than in Canada—when their affairs must be conducted more on the lines followed in older countries. Natural riches almost unlimited would permit extravagance for a time, but prudence should prevail. He then referred to the extremely handsome and kind welcome accorded to members of the Institution on their recent visit; nothing was left undone to ensure the comfort and instruction of the visitors, as they all could testify.

Replying for Canada, Lord Strathcona said that they had had many visits from British scientific institutions in recent years, and all were heartily welcomed as fellow subjects of their gracious sovereign. There were no more true, loyal and devoted subjects and lovers of the Empire than those in the Dominion. The immense resources of Canada were not fully realised at Home. He foretold a vast expansion of the population of Canada, every inch of which was a "white man's country." Engineering works would tell in the new countries even more in the future than now.

Mr. W. I. Buchanan in his reply referred to the characteristic caution of British engineers, which led them to impose a time limit even on speeches. The kind words which had been uttered were but the echoes of the expressions of esteem and gratification heard in the United States with regard to the visit of the British engineers, whom he congratulated on passing through that experience with unimpaired digestions. Quoting the suggestion of an English novelist, that after a man had delivered an enthusiastic eulogy, his friends would take him aside and ask him what was his *private* opinion, Mr. Buchanan said that the visitors had seen both the efforts at progress and the shortcomings of their hosts, and he would like to know *their* private opinions. The Americans felt that the British had still some industrial and fiscal problems to solve. These periodical trips added breadth of observation and knowledge, and made engineers the tacticians of the industrial world. Referring to the "exuberant imagery" of British engineers in drafting specifications, he spoke again of their evident caution, in making themselves at once their own critics, judges, executors and residuary legatees. He concluded with an allusion to the soft, even skyline and pastoral quiet of New York, and to the humble, modest and bucolic people who dwelt there.

Mr. R. Hammond, proposing "Our Guests," complained that after Mr. Buchanan's onslaught upon the consulting engineer, he was now obliged to drink his health. He concluded with a tribute to the high integrity of Sir H. B. Buckley, whose patient hearing and painstaking judgements had laid the electrical world under a debt of gratitude. Sir Henry Buckley, in reply, expressed his interest in science, and his desire to be informed what electricity was—an aspiration apparently never to be satisfied.

The company then adjourned to the Victoria Hall, where they

were able to chat with freedom, this being a feature which contributes greatly to the popularity of the Institution's annual dinner. A programme of music was performed by the Imperial Orchestra during the dinner, and in the Victoria Hall. The occasion was a record one, and passed off with entire success.

THE "MEGGER."

We recently inspected "Evershed's Patent Megger," the new self-contained ohmmeter and generator for testing insulation resistance, which has been put on the market this month by Messrs. Evershed and Vignoles, Ltd., of Acton Lane Works, Chiswick. This instrument, which has been in the course of evolution for the last four years, is a natural development from the well-known testing set of world-wide reputation, and must be admitted to be a credit to its parentage, for it is the most ingenious and perfect practical testing instrument that we have seen.

As shown in the accompanying illustration, fig. 1, the apparatus is entirely contained in one box; the hand dynamo, which is very easy-running, gives pressures up to 1,000 volts, and the ohmmeter reads up to no less than 2,000 megohms.

The scale is direct reading and approximately logarithmic, giving nearly uniform accuracy over a very wide range, so that it has been possible to dispense with the use of shunts and the second scale for low resistances; the dial is covered with a hinged lid, inside which are the printed directions for use. The movement is perfectly dead-beat and astatic, so that the reading is obtained directly the handle of the generator is turned at full speed—that is, in a few seconds at most—and is unaffected by stray fields.

There are only two terminals, respectively marked Line and Earth, and the former is provided with a guard ring, so that internal leakage is entirely harmless. The instrument does not need levelling, except in the highest ranges. A leather handle is provided for carrying the instrument, which weighs in all 18 lbs.; the handle is detachable by means of a novel patent latch at one end, to expose the dial. The generator handle folds back when not in use. The dimensions of the box are $6\frac{1}{4} \times 6\frac{1}{4} \times 12$ in.

The dynamo is of the same type as of old, and is noteworthy for its tiny roller bearings and the ingenious mode of current collection, the commutator taking the shape of divided disks, running in contact with pivoted spring disks, with the minimum of friction and the maximum of reliability and durability. The E.M.F. in the high-range instruments has to be exceedingly uniform, on account of the presence of capacity in the cables tested; although fluctuations of voltage have no effect on pure resistance tests, the surgings set up thereby when capacity is present would vitiate the readings, and to avoid this defect the generator in this case has eight coils, and is provided with an absurdly simple constant speed device, consisting of a centrifugally operated clutch. So effectual is this, that we can vouch for the fact that, after the normal speed of rotation of the handle is attained, the voltage remains constant, no matter how much faster the handle is turned. This is a most striking and unexpected feature of the apparatus, and renders it applicable to the testing of cables of large capacity. The high range instruments are also provided with a terminal, to which the guard wire, essential to accuracy in cable testing, can be attached. This is, we believe, the only self-contained instrument in existence which enables one to test the insulation resistance of a few hundred yards of cable at pressures up to 1,000 volts.

So far we have not referred to the fundamental novelty in the construction of the ohmmeter—namely, the fact that the movement is of the moving-coil type. To this must be ascribed the enormous increase in the sensibility and aperiodicity of the instrument.

As shown in the diagram, fig. 2, the permanent magnet system is common to both the generator and the ohmmeter. The movement consists of a current coil, passing twice through the field in the annular space between the pole-pieces and the cylindrical core, and a pressure coil, of which one leg is axial with regard to the movement, and the other leg moves in the field. To the latter is attached a little compensating coil in series with the pressure coil, which ensures immunity from interference due to stray fields. The coils are wound on copper formers, which give the dead-beat quality, and are carried on steel pivots with strong spherical ends working in sapphire bearings. Thanks to the vibration due to the gearing of the generator, frictional errors are entirely eliminated, whilst the pivots are so strong that there is absolutely no risk of breaking them. The currents are led into the movement by means of patent phosphor-bronze strips a fraction of a mil in thickness, which exercise a control less than 1/400 of that of the pressure coil, and are so guided by means of light bobbins that they cannot become entangled or displaced. The movement is balanced, and it is only in the instruments of the highest range that levelling screws have to be provided.

The internal mechanism requires no attention, so the cover of the box is sealed dust-tight (with a dust-proof washer on the spindle which carries the handle), and is screwed down.

We may note that the principle of the ohmmeter is identical with that of the older types; the only essential difference is that it has been turned inside out—the magnetic needle, so to speak, is fixed, and the coils are free to move. But this change has resulted in an immense improvement. The foregoing is but a brief description, but may serve to indicate the remarkable progress that has been made by Messrs. Evershed & Vignoles, who have not been content to "let well alone," but have laboured incessantly to surpass their own high standard of excellence.

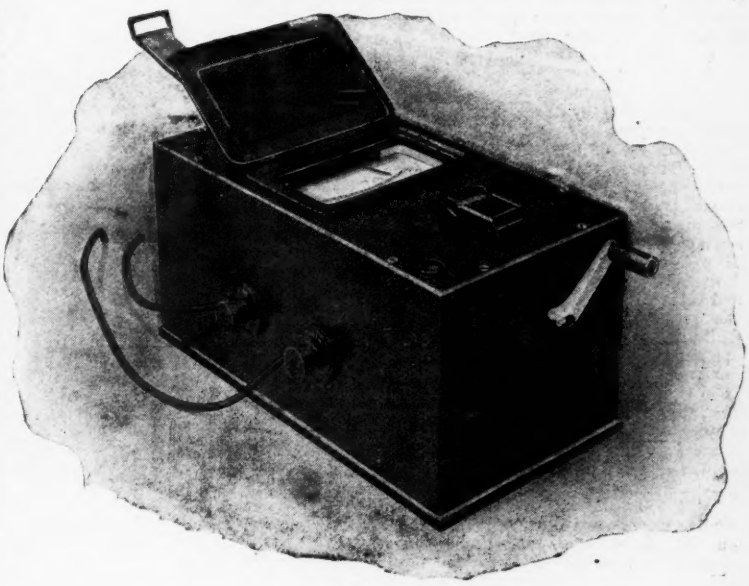


Fig. 1.—Evershed's Patent "Megger."

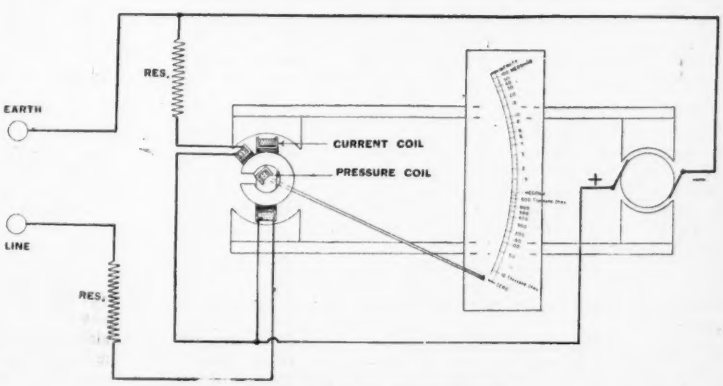


Fig. 2.—Diagram of Connections.

LEGAL.

Estler Bros. *v.* J. Tylor & Sons, Ltd.

In the Chancery Division of the High Court of Justice, on 30th ult., Mr. Justice Farwell had before him an action by Estler Bros., electrical engineers and manufacturers of electric traction materials, Laurence Pountney Lane, E.C., and Victoria Docks, London, against J. Tylor & Sons, Ltd., sanitary engineers and iron and brass founders, Newgate Street, London. Plaintiffs claimed (1) damages for breach of an agreement made between the plaintiffs and defendants, whereby the defendants agreed not to manufacture, advertise, or sell any castings made by them from drawings, designs, or patterns belonging to plaintiffs, and entrusted to the defendants for the purpose of manufacture for the use of the plaintiffs. (2) Damages for breach of an implied contract not to manufacture, advertise, or sell any castings made by the defendants from drawings, designs, or patterns of the plaintiffs. (3) An injunction to restrain the breach of agreement and breach of confidence. (4) Delivery up of all appliances, castings, fittings and patterns belonging to plaintiffs. (5) An injunction to restrain the defendants from

printing or distributing any catalogues, photos drawings or copies constituting an infringement of the plaintiffs' copyright in their catalogues, "Ambroin Overhead Trolley-line Materials," and "Souvenir of the Second International Tramways and Light Railways Exhibition," "The Estler Air-gap Section Insulator," and "Wilkinson's Patent Trolley-head Improved Patterns," registered March 29th, 1904. (6) Delivering up to the plaintiffs of all copies, catalogues and drawings constituting the infringement. Plaintiffs further claimed an account of the profits made by the defendants of sales of fittings based on plaintiffs' drawings, designs, or patterns.

Mr. Upjohn, K.C., and Mr. Cecil Walsh appeared for the plaintiffs, and Mr. Jenkins, K.C., and Mr. Percy Wheeler for the defendants.

Mr. Upjohn, in opening the case, said the plaintiffs, who had not then, as they had now, a foundry, got into communication with the defendants, and employed them to cast appliances which it was the business of the plaintiffs to sell. It was agreed that whatever designs, drawings, or patterns, &c., were sent to the defendants, should be treated as confidential, and should not be used by defendants for their own purposes, or the purposes of other customers. In 1902 the defendants sent a letter to the plaintiffs asking them for an estimate for designing electrical plant in conformance with a specification for some corporation. Plaintiffs replied that, as a matter of fact, they had got these specifications, and were competing themselves. In 1904 plaintiffs were astonished to find that the defendants had got out a catalogue of electric traction equipment, and the illustrations were principally photographs of castings from plaintiffs' own drawings. The defendants said that the manufacture and supply of electric traction materials formed a part of their business. Defendants admitted that in October, 1900, they undertook to manufacture castings, &c., from designs and drawings supplied by plaintiffs, but they denied that the contract they entered into contained the express terms alleged by the plaintiffs, or that there was a verbal agreement of the nature alleged. Defendants did not admit that any of the designs, drawings, patterns or samples, supplied to them were original. They further denied that there was any such custom in the trade as that alleged. Defendants admitted that they had advertised, and continued to advertise, fittings, castings, and appliances which were reproductions of some of the fittings, castings, and appliances made by them for the plaintiffs in pursuance of the directions given by the plaintiffs, and that in so doing they had made use of the metal or plate patterns manufactured by the defendants. Defendants further admitted that they had advertised such fittings, castings, and appliances in an illustrated catalogue of electric traction equipment, containing illustrations from photographs taken from some of the fittings, castings, and appliances made by the defendants for the plaintiffs. The fittings, castings, and appliances so reproduced and advertised, defendants said, were common to the trade. In 1900 the plaintiffs and half a dozen other firms were the only people who carried on the business of manufacturing such electrical equipment. Defendants, counsel submitted, had no experience or knowledge to enable them to make designs of their own. The plaintiffs were anxious to know the plates and patterns of defendants' own designs, from which defendants said they manufactured. Defendants said that, so far as they were at present able to give particulars, it was a section of an insulator.

Mr. Paul Estler gave evidence to the effect that many of the designs in defendants' catalogue of 1904 were similar to the designs plaintiffs had given defendants to make patterns and castings from.

On 1st inst. Mr. Ernest Paul Estler gave evidence of a similar nature to that of the previous witness, and said Mr. Bright, one of the directors of the defendant firm, had agreed not to make fittings from plaintiffs' patterns for any other person or firm. This was a new class of business defendants were now carrying on.

Mr. Charles Mittlehausen, M.I.C.E., and Mr. Thomas Bate, gave evidence as to a customary understanding in the engineering trade in regard to designs, &c. This closed plaintiffs' case.

Mr. Phillip Bright, examined, said he was managing director of the defendant company. Nothing had been agreed as to what defendants might do with the patterns made from drawings or samples sent by plaintiffs. All the drawings, samples and patterns sent by the plaintiffs were plaintiffs' property, and were returned when asked for. As to the metal patterns, the defendants never charged the plaintiffs anything for them, and he thought the founder had a right to use them. If it were an absolutely original design, then he did not think the founder had a right to use it at all for the purpose of selling to others. He believed when he published the catalogue that all the articles in it were common to the trade. He was quite sure they had not supplied any order on the footing of this catalogue.

Cross-examined: He thought September 14th, 1901, was the first date they sold finished electrical articles of any manufacture other than the plaintiffs'. They sold these to the General Electric Company.

Before the witness had concluded his evidence, Mr. Jenkins, in the course of some discussion, said it might be well for him to state what his intentions were. He was to have put another member of the defendant firm in the box to give his version of whether there had been a verbal agreement. Defendants had always contended that the articles appearing in the catalogue were common to the trade. He thought that an honest mistake had been made about that, and he was bound to confess on the facts proved that certainly some of the articles were not common to the trade. After Mr. Bright had stated that he ought not to use patterns except of things which were common to the trade, counsel did not propose to call evidence to suggest that the custom was confined to patented and registered designs. He wished to make an end of the whole thing. They would put an end to any copies of the catalogue still in their possession, the metal castings would be destroyed, and they would start afresh.

Defendants ultimately submitted to an injunction restraining them from making any castings based upon patterns, designs, or samples supplied to them by the plaintiffs or any reproductions of patterns or castings which defendants had made for the plaintiffs. Defendants further undertook to destroy all such castings in their possession, as well as copies of the catalogue complained of. Plaintiffs did not press the part of the claim based upon copyright, and in respect of this issue the Judge deprived them of their costs.

Hampshire *v.* Bradford Corporation.

An action was heard on the 5th inst. at the Leeds Assizes in which a clerk named Hampshire, who had been struck by a falling trolley wire when travelling on one of the defendants cars, claimed damages. He was awarded £150.

Underground Electric Railways Co. of London, Ltd., *v.* The Commissioners of Inland Revenue.

This case came before the Court of Appeal, composed of the Master of the Rolls, and Lords Justices Stirling and Mathew, on Tuesday, on the appeal of the Commissioners from a judgement of Mr. Justice Channell in the King's Bench Division. It was a special case raising an important question as to the amount of stamp duty payable by the company under the agreement by which it acquired control of the Brompton and Piccadilly Circus Railway, the Charing Cross, Euston and Hampstead Railway, the Great Northern and Strand Railway, and the Baker Street and Waterloo Railway.

From the special case, it appeared that by an agreement dated June 25th, 1902, with the Metropolitan District Electric Traction Co., Ltd., the Underground Electric Railways Co., which had a capital of £5,000,000, agreed to purchase the whole of its undertaking. Part of the consideration for the sale was (1) that £500,000 should be paid in cash by the new company, on completion of the purchase, together with interest at the rate of 5 per cent. per annum on £250,000; (2) £500,000 in shares; and (3) the profits in the new company available for dividend in respect of each year, should be applied:—(*a*) In payment of a cumulative dividend at the rate of 5 per cent. per annum on the amount for the time being paid up on any shares issued by the new company; and (*b*) in paying to the Traction Co., or its assigns, as a further part of the consideration for the sale, such a sum as should be equal to a dividend of 3 per cent. on the amount for the time being paid up on such of the original ordinary share capital of £5,000,000 in the new company as should for the time being have been issued by the new company. On July 8th, 1902, an instrument was presented on behalf of the new company for the purpose of being stamped, and the Commissioners, in assessing the duty payable, computed the consideration for the property agreed to be sold as £1,947,583 18s. 5d, which, after making certain deductions, was put at £1,527,357 17s. 11d. The question was whether the Commissioners were right in including therein £780,000 under Clause 3 of the agreement. The Commissioners held that the sum contingently payable out of the profits in each year under the sub-clause was "part of the consideration for the sale," and that, so far as such sum was capable of ascertainment at the date of the agreement, it was liable to *ad valorem* conveyance duty at the rate of 10 per cent. The company, on the other hand, submitted that such sum was incapable of assignment by reason of the remoteness of the contingency upon which the payment must be made. Mr. Justice Channell gave judgement for the Underground Electric Railways Co. with costs; hence the present appeal of the Commissioners.

The Attorney-General and Mr. Rowlatt appeared for the appellants, and Mr. Roskill, K.C., and Mr. Austin Carpmael for the company.

At the conclusion of the arguments, their Lordships adopted the contentions of the Commissioners, reversed the decision of Mr. Justice Channell, and entered judgement for the Crown for the amount claimed.

Mr. Roskill asked for a stay of execution with a view to the company considering whether they would take the case to the House of Lords.

A stay of execution was granted for one month.

J. Bakewell & Co., Ltd.

Mr. Justice Warrington, in the Winding-up Court on Tuesday, had before him a summons asking for the removal of Mr. Joseph Bakewell, who was stated to be promoter and managing director of the company, and with his family, the largest shareholder, from the position of liquidator. Affidavits were read stating on the one side that a committee of shareholders had been formed and had discovered irregularities which they thought ought to be inquired into, and on the other, that the removal of the liquidator would be prejudicial to the business of the company, which had a number of contracts for electric lighting in various parts of the country, including some with municipal authorities. Mr. Bakewell had prepared an affidavit in which he stated that he had been a working electrician, and had done a small but lucrative business until the formation of the company, whose registered address was King William Street, E.C., and added that he was more competent to conclude the liquidation than Mr. Stanley, the gentleman

suggested by the committee of shareholders as his successor. Part of the opposition came from members of a family who had personal reasons for attacking him, they having made claims which he had disallowed.

In giving judgement, his Lordship referred to a report which had been made by an accountant, which, to say the least, was an unfavourable one. It was not satisfactory that when matters were brought before the liquidator which demanded investigation, he should meet them by expressing his willingness that the Court should inquire into them. There ought to be a liquidator who was not in such a position, that in order to do his duty he must come to the Court and ask what it was. On the whole, due cause had been shown, and he should grant the application appointing Mr. Stanley liquidator.

Manchester Cabriage and Tramways Co. *v.* Swinton and Pendlebury U.D.Cs.

The matter of this arbitration came before the Court of Appeal, composed of the Master of the Rolls, and Lords Justices Stirling and Mathew last week, on the appeal of the purchasing authority from a judgement of Mr. Justice Channell in the King's Bench Division.

This was a special case stated on May 28th, 1903, by Sir Fredk. Bramwell as to whether the District Council were to purchase any of the company's depôts outside the district of the Council. Sec. 43 of the Tramways Act, under which the purchase was to be made, is as follows, so far as material:—"Where the promoters of a tramway in a district are not the local authority, the local authority . . . . may (within certain specified times) . . . . by notice in writing, require such promoters to sell, and thereupon such promoters shall sell to them their undertaking, or so much of the same as is within such district upon terms of paying the then value . . . . of the tramway, and all lands, buildings, works, material and plant of the promoters suitable to and used by them for the purposes of their undertaking within such district." The question which arose upon the appeal was whether the words "within such district," qualified the word "undertaking" so that a depôt outside the Council's district, but suitable to and used for the purposes of such part of the undertaking as was within such district, was to be taken and paid for by the Council. The Council contended that the words "within the district" qualified the words "lands, buildings, work, material, and plant," and that, therefore, the depôt, being outside their district, could not pass. It seemed that there were two depôts, both outside the Council's district, but at the depôt at Church Street the cars and horses of the line were kept. The special case found, as a fact, that the Church Street depôt was "suitable to and used with" the undertaking, but that the other depôt was not. Mr. Justice Channell upheld the special case. Hence the present appeal.

Mr. Pickford, K.C., and Mr. Rhodes appeared for the appellants, and Mr. Fletcher Moulton, K.C., Mr. Astbury, K.C., Mr. Edridge and Mr. Sanders for the respondents.

On Saturday the Master of the Rolls, in giving judgement, after stating the facts, said the question for decision arose under Section 43 of the Tramways Act, 1870, and was whether in the case of a depôt situated as the one in Church Street was—viz., geographically outside the purchasing authority's district—the purchasing authority was liable to take it over and pay for it. Sir F. Bramwell, in the special case stated by him, had set out in a very elaborate manner, described exactly the physical conditions of this depôt and the purposes for which it was used, and he then formulated certain conclusions with respect to it. It seemed to his Lordship that the arbitrator, having so minutely set out all the circumstances surrounding the case, treated the question as one of law, and it was open to this Court now to deal with the case on that footing. It was important to notice that, in order to get to the depôt in question from the Council's district, it was necessary to first pass over the main line of the Salford Corporation, and then over a spur line, the depôt itself being within the district of the Salford Corporation. The Council said that the company were not in a position to pass to them the right to use either the Salford Corporation's main line or the spur line, and therefore as they could not sell that which would enable the depôt to be used, the depôt was not suitable to, and used by them for the purposes of the undertaking within the meaning of the Section. Whether or not the company could pass the right to use the Salford main line was a question upon which he would express no opinion, but it was perfectly clear that whatever rights they possessed with regard to that line, those rights did not extend to the spur line. That being so, the tramway company, not being in a position to give the right of access to the depôt in question, it clearly could not be said to be suitable to the undertaking within the meaning of the Section. The company, in his opinion, had failed to show conclusively that there was an obligation on the district Council to pay £24,000 in respect of that depôt. For these reasons he thought the appeal must be allowed.

The Lords Justices concurred.

Hall *v.* Liverpool Corporation.

On Tuesday, at the Liverpool Assizes, Mr. E. F. Hall, of Prescot, prosecuted the Corporation of Liverpool to recover damages for injuries caused by a conductor on one of the Corporation's tramcars. The facts, as reported in the *Morning Post*, are that plaintiff was a passenger on June 22nd, and entered the car smoking a cigar. He alleged that, on taking his seat, he ceased to smoke, but admitted holding the cigar in his hand. He was requested by the conductor to put the cigar out or leave. Plaintiff, however, protested that he was not smoking, and declined to leave. He gave the conductor his name and address, and the car proceeded, but subsequently the conductor again required him to throw away the cigar or leave the car, and on his refusing to do either, the conductor, a powerful man, put him off the car, with the result that his leg was broken, and he suffered a severe shock. He was 67 years of age. For the Corporation it was contended that the conductor did what he was entitled to do, the plaintiff having refused to obey the bye-laws. The breaking of the leg was a regrettable accident. The jury awarded the plaintiff £1,000, and judgement was entered accordingly.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending December 1st, 1903.	
Alexandria	Value £22
Amsterdam	54
Antwerp. Elec. fuse	584
Bombay	38
Buenos Ayres	255
Calcutta	2,419
" Teleg. mat.	201
Canada (*via* States)	92
Cape Town	1,309
Colombo	103
Delagoa Bay	238
" Teleg. mat. ..	1,287
Durban	848
East London	147
Flushing	50
Hamburg. Teleg. mat.	50
Hong Kong	73
" Teleg. mat. ..	95
Madras	299
Malta	17
Melbourne	50
Monte Video	104
Napier	33
Perth	54
Port Elizabeth	87
Rio de Janeiro	17
Rotterdam	15
Shanghai	200
Singapore	89
" Teleg. mat.	89
Stockholm. Teleg. wire ..	134
Sydney	2,594
" Elec. cable	2,900
Trinidad	25
Total ..	£14,502

Week ending November 29th, 1904.	
Aalsund	Value £63
Adelaide. Teleg. mat.	1,020
Aden	18
" Teleg. mat.	122
Amsterdam	68
" Elec. machinery ..	668
Antigua	110
Bombay	4,661
" Elec. machinery ..	176
" Teleg. mat.	515
Buenos Ayres	1,518
Calcutta	694
" Elec. machinery ..	76
Cape Town	29
" Teleg. mat. ..	310
Chinde	17
Christiania	21
Cologne	12
Colombo	5
" Teleg. mat.	6
Copenhagen. Elec. cable ..	46
Demerara	20
Durban	885
" Elec. machinery ..	330
" Teleg. mat.	117
East London	7
Fremantle	11
Ghent	15
Gothenburg	16
Halifax	92
Hong Kong. Elec. cable ..	230
Lyttelton	30
" Elec. cable	1,180
Madras	190
" Elec. cable	235
" Elec. machinery ..	591
Marseilles	44
Melbourne	110
" Elec. machinery ..	258
Otago	29
Paris	119
" Elec. machinery	865
Penang	322
Perth. Elec. machinery ..	30
Port Elizabeth	47
" Elec. machinery	12
Rio Janeiro	42
" Teleg. mat. ..	4,070
Shanghai	20
Singapore	417
" Elec. cable	539
" Teleg. mat.	180
Suez. Teleg. mat.	104
Sydney	529
Toronto	40
Wellington	183
Total	£21,966

Foreign Goods Transhipped.

New York. Elec. apprts.	Value £102
Gothenburg. Telephones	Value £425
St. Petersburg. Elec. apparatus	70
Total ..	£495

Sisson's Engines.—Messrs. W. Sisson & Co., Ltd, of Gloucester, have recently booked the following contracts for their patent high-speed enclosed self-lubricating engines:—

One 35-B.H.P. for Gloucester Railway Carriage and Wagon Co., Ltd., for their Cardiff branch.
One 120-B.H.P. for Mr. A. Moir, of London.
One 40-B.H.P. for General Electric Co., Ltd., of Witton.
One 70-B.H.P. for Washington Chemical Co., Ltd., Co. Durham.

The Nesdrum Boiler.—This boiler, which is made by Messrs. Richardsons, Westgarth & Co., of Hartlepool, is offered to the consideration of engineers on the ground that it is a water-tube boiler with straight tubes, and has a furnace which possesses a large capacity in the shape of height above the grate, and of which three sides are of brickwork, while the fourth for water tubes is screened off from the passages for the furnace gases by a baffle, compelling all gases to travel the full height of the furnace. The tubes are held between a pair of annular drums, each pair of drum-heads then forming a long nest of tubes which are arranged together in sufficient number to make up the width of a boiler. Thus a boiler may consist of three such nests in width, and two sets of three nests each are placed parallel with each other and inclined slightly from the vertical. The drums are connected top and bottom to each other, and to an upper transverse steam drum, beyond which is connected a third set of three nests of pipes; or there may be three sets of nests in front of the steam drum and one behind. By suitable choice of the number of nests, a boiler of any desired size is built up. The boiler is made under Hornsby's patents.

Westinghouse Awards at St. Louis.—In addition to the special award in the Department of Machinery, no fewer than 12 grand prizes and 25 ordinary awards have fallen to the share of Westinghouse enterprises. The plant that secured this success comprises the stock products of the companies as follows:—A.C. generators and motors, A.C. turbo-generator installation, transformers and rotary converters, D.C. generators and motors, electric railway motors, A.C. and D.C. control systems for single and multiple unit operation, mining and industrial locomotives, horizontal gas engines and steam turbines, air brakes and friction draught gears, electric car brakes, air brakes and accessories for signal systems, development of mercury vapour lamps. The gold medals the Westinghouse companies received are as follows:—For complete A.C. and D.C. switchboards, Bremer arc lamps and arc lighting system, Nernst lamps, Cooper-Hewitt lamps for photo-engraving, water and gas meters, electric measuring instruments, and for industrial betterment work and housing of the working class.

Roller Bearings.—The advantages of roller bearings in reducing friction have long been known and admitted, but owing to the difficulty of applying them practically so as to be reliable under varying loads, their general application has hitherto been limited. The chief difficulties to be overcome have been (*a*) torsional or cross winding of the rollers in their paths; (*b*) the correct relative proportions between the load to be carried and the diameter of the rollers; and (*c*) their durability as regards their hardness and inflexibility under severe strains. The application of ball bearings to heavy loads has been admitted to be impracticable, owing to the liability of the balls to crushing or flattening, combined with the certainty of indentation or cutting of a race in the roller path. On the other hand, the introduction of a roller of equal hardness and tensile strength enables the load to be carried on a straight line throughout the bearing surfaces on the roller path. One of the chief difficulties to be overcome has been that of so arranging the bearing as to preserve its true parallelism with the journal or shaft on which it rotates, and to provide against any one part of the roller taking an unequal share of its load by reason of its rigidity in its bearing; and another has been that of producing rollers and a roller path of such reliability as not merely to withstand the stresses of heavy loads and high speeds, but to ensure that there shall be no failure of any of the parts due to uneven or unequal wear either of the rollers or of the journals on which they revolve.

The Empire Roller Bearings Co., as successors of the Roller Bearings Co., Ltd. (which was established in 1896) took up the subject at the point where the former company left it in 1900, and they have successfully established roller bearings upon the market as a commercial article. The L.B. & S.C.R. Co. for upwards of six years experimented with the axle-box bearings of the earlier type, and the results obtained have led to their trial by this company upon their main-line fast trains running between Brighton and London daily. The bearings were proved to be thoroughly durable and efficient after nearly two years of continuous running, during which time they had covered a distance of at least 80,000 miles. The railway company has now decided to test the economy in tractive effort, for which purpose a whole train is to be fitted throughout with roller bearings.

These roller bearings have been employed for motor road wagons, in which for several years past they have been in constant use with the most gratifying results, and for tramcars, such as, for example, those of the Croydon Corporation, and the Southport tramways, where for upwards of two years a large number of cars fitted with roller bearings have been successfully working, and where the economies in current consumption due to their adoption have been shown to be as much as from 20 to 35 per cent., measured in units per car-mile. They are equally successful upon the cars of the Corporations of Hull, Liverpool, Sheffield, &c. For works shafting, the saving in power has been shown to be as much as from 50 to 70 per cent. in driving the machinery.

These roller bearings have also been supplied to the Colonies, including the Cape Government railways, to the Indian Government, to the French railway companies, and to the South American railways, both for railway rolling stock and light trolley work, and have recently been fitted to the revolving stages of the new Coliseum now being constructed in London, where their adoption has enabled the supply of electrical power for the machinery to be very largely reduced.

Duplex Station Voltmeters.—We have received from Messrs. Nalder Bros. & Thompson the following letter on this subject:—

Messrs. Evershed & Vignoles, in writing to you drawing attention to the double voltmeter arrangement of which they sent you illustration, quite miss the point of our instrument, which you were good enough to illustrate recently in your paper, namely, that it is an illuminated dial edgewise combination of voltmeters, arranged to turn about a vertical axis, and capable of swinging through 120°, or more if necessary. The arrangement which they illustrate is an old one, which we ourselves have made for sundry supply stations during the last few years, so we hardly thought it was worth while to draw attention to this combination, which, though excellent in itself, presents no features of novelty.

Faithfully yours,

Nalder Bros. & Thompson, Ltd.

Fras. H. Nalder, *Managing Director.*

German Electrical Machinery Trade.—So far this year there has been an increase in the exportation of electrical machinery from Germany, the returns for the nine months ending with September last showing a total of 9,857 tons, as contrasted with only 9,695 tons in the corresponding period of last year. There has also been an increase in the importation of foreign electrical machinery into Germany—from 662 tons in the first nine months of 1903, to 1,001 tons in the nine months ending with September last.

Destructor Contract.—Messrs. Meldrum Bros., Ltd., of Manchester, have just received from the Admiralty a contract for one of their well-known "Simplex" regenerative refuse destructors with steam-generating plant. This is to be erected at Chatham Dockyard in connection with the large electric power plant which is being installed under the direction of Messrs. Preece and Cardew, the Admiralty's consulting engineers.

Private Bills in the Coming Session.—The plans of Bills deposited already in the Private Bill Office for the session of 1905 include the following:—

Railways.—Baker Street and Waterloo; Central London (New Lines); Charing Cross, Euston and Hampstead; Edgware and Hampstead; Great Northern, Piccadilly and Brompton (Nos. 1 and 2); Hammersmith, City and North-East London; and North-East London.

Tramways.—Aberdare; Gosport and Fareham; Hastings; Liverpool Corporation; London County Council; London Southern; Metropolitan Electric; Oldham and Saddleworth District; and Wellingborough and District Tramroads and Electricity Supply.

Miscellaneous.—Administrative County of London and District Electric Power Co.; Andover Lighting and Power; Birmingham Corporation; Bolton Corporation; Bootle Corporation; Bristol Corporation; Bury Corporation; Central Electric Supply Co.; County of London Electric Supply; Croydon Corporation; East London and Lower Thames Electric Power; Halifax Corporation; Morley Corporation; Shropshire and Worcestershire Electric Power; and South Wales Electrical Power Distribution Co.

An Australian Mining Plant.—According to *Australasian Hardware and Machinery*, an electrical mining plant has been installed by the Cathcart Proprietary Gold Mines. It was supplied by the Austral Otis Engineering Co., Ltd., as agents for Ganz & Co., of Budapesth, and includes several Ganz motors. There are two steel boilers, 12 ft. × 6 ft. 6 in. in diameter; a Belliss compound engine of 158 B.H.P., coupled to a Ganz three-phase generator of 110 KW. output. A triplex plunger pump with a capacity of 25,000 gallons per hour, is driven by a 45-B.H.P. Ganz motor of the three-phase enclosed type. The winding gear, which is designed to lift a load of 18 cwt. balanced, or 30 cwt. unbalanced, at the rate of 500 ft. per minute, is driven by a Ganz three-phase motor of 44 B.H.P. nom. and 60 B.H.P. maximum. When erected the puddlers will also be electrically driven by a similar motor of 34 B.H.P. The whole of the engine-house and surface erections will be lighted by electricity, the outlay of the company in connection with the new plant being about £6,000.

New Works at Trafford Park.—A Manchester newspaper says that the American Car and Foundry Co. have acquired a site in Trafford Park for the purpose of erecting large works for the manufacture of railway wagons and carriages. The company already possess fifteen large works in the United States, and their daily output is more than 300 wagons and carriages. They have just undertaken a contract for the supply of the railway carriages for the Baker Street and Waterloo Underground Railway in London. All these carriages will be built and finished at the new establishment in Trafford Park. The only portion of the work which will be imported will be the steel work, which will be received in a finished state. The remainder of the work will be done in England. The company expect to have the workshops erected and the necessary equipment installed, and to commence delivering the finished carriages, early in March.

Book Notices.—"Fowler's Mechanical Engineers' Pocket Book, 1905." By W. H. Fowler. Manchester: Scientific Publishing Co. Leatherette and red edges, 1s. 6d. net; leather and gilt edges, 2s. 6d. net.

"Producer Gas." By A. H. Sexton. Manchester: The Scientific Publishing Co. 10s. net.

"A Treatise on the Theory of Alternating Currents." By Alexander Russell. Cambridge: University Press. 12s. net.

"Fire Tests with Lamps." London: The British Fire Prevention Committee. 2s. 6d.

"Science Abstracts." Sections A, Physics; B, Electrical Engineering. November 25th, 1904. London: E. & F. N. Spon. 1s. 6d. each.

"Who's Who," 1905. London: A. & C. Black. 7s. 6d. net.

"Who's Who Year-Book," 1905. London: A. & C. Black. 1s. net.

"Englishwoman's Year-Book and Directory," 1905. By E. Janes. London: A. & C. Black. 2s. 6d. net.

"Petrol Motors and Motor-Cars." By T. H. White. London: Longmans, Green & Co. 4s. 6d. net.

The *P. and O. Diary and Almanac*, for 1905, has come to hand. As well as being a diary of convenient size for many purposes, it is useful because of its maps of the Continent, India, Australia, &c., and of its quantity of information respecting the steamship service of the P. & O. Co., agents and correspondents in different parts of the world, mail dates, table of sea distances, &c. It should be an invaluable compendium for mercantile houses in the United Kingdom.

Plant for Sale.—The Bridlington Corporation is offering a 42-B.H.P. gas engine, arc lighting dynamo, arc lamps, cable &c., for sale, consequent upon the opening of the new lighting station. Manchester Corporation invites offers for two 750-KW. Ferranti-Westinghouse continuous-current compound-wound sets, now at Dickinson Street station. See our advertisement pages to-day for particulars.

Bankruptcy Proceedings.—The public examination was held before Mr. Registrar Giffard on Wednesday last week at the London Bankruptcy Court of Arthur Edgar Brooks, 110, Cheapside, electrical engineer, trading as Brooks & Brooks. The statement of affairs shows total liabilities £5,711 16s. 6d., of which £2,352 0s. 3d. is expected to rank, against assets valued at £37 15s. In the course of a lengthy examination by Mr. C A. Pope, Assistant Receiver, the debtor stated that since 1896 he had been interested in the business carried on at 110, Cheapside, as Law's Peach Bitters. Then in 1901 he entered into partnership with Mr. S. O. Cook, and they commenced business as electrical engineers at the same address. The debtor added that he put in £150, which he borrowed from his mother, and Mr. Cook provided no capital. The latter retired from the firm in 1903, leaving the business to witness, who continued it to the date of the receiving order. Very little business, however, had been done during the past summer. His failure was entirely due to liabilities which he had contracted as surety for others, the electrical business having been carried on at a profit throughout. The examination was ordered to be concluded.

The first meeting of creditors was held on Wednesday last week at the London Bankruptcy Court, under the failure of Harry Arthur White, electrical engineer, lately carrying on business as Ridout and Co., at 45, Highgate Hill, N. The receiving order was made on November 10th, upon the petition of the General Electric Co., Ltd., the act of bankruptcy alleged being non-compliance with the requirements of the bankruptcy notice duly served upon the debtor. It was stated that the debtor had sold off his stock-in-trade, and the premises are now empty. The meeting was adjourned for three weeks, the debtor having lodged an application to rescind the receiving order, on the grounds:—(1) That a notice of bankruptcy was never served upon him or had come to his knowledge; (2) That the petition was not personally served upon him; and (3) That until November 10th he had no formal notice of any proceedings in bankruptcy being taken against him.

Last week a first meeting of creditors was held under the receiving order made against Mr. Arthur William Wigmore, physician and surgeon, of Hampstead, and Welbeck Street, W., who for two years has practised as a skin specialist and Röntgen rays expert, and attributes his failure mainly to the heavy expenses of his practice in Welbeck Street, to inability of patients to pay full fees by reason of financial depression, and to alleged injurious effects caused by the X-rays as used by some practitioners. The matter remained in the hands of the Official Receiver to be wound up in bankruptcy.

At Nottingham on November 30th a meeting of the creditors of Albert Smith, electrical engineer, of Nottingham (Electric Motor Supply Co.) was held. The unsecured liabilities amount to £745, gross debts £808, assets estimated to realise £264, and a deficiency of £491 13s. Debtor commenced business in Sept, 1903, he taking over the assets and liabilities of the business carried on by his father and a partner for the consideration of £40. The liabilities exceeded his assets to some extent, but debtor considered the business could be made solvent. He attributes his insolvency to embarrassments arising from having to make good these liabilities, to loss on a contract, and to general decline of trade. The winding up of the estate was left in the hands of the creditors. The public examination of the debtor took place at Nottingham Bankruptcy Court on Friday, when debtor stated that the liabilities attached to the business when he took it over amounted to £200. At one time he considerably reduced his liabilities, but at the beginning of 1904 there was a period of bad trade, and through having to make good some bad work done by the old firm, his liabilities increased, and he was unable to meet them. The examination was closed. December 22nd is the last day for receiving proofs in this case. The trustee is Mr. T. Gourlay, 4, Castle Place, Park Street, Nottingham.

The first meeting and public examination in *re* Harry Cooke, electrical engineer, of Longton, are to be held on December 19th, at the Town Hall, Stoke-on-Trent.

Dissolutions and Liquidations.—Messrs. E. Gandy and R. H. Dewbery (Premier Engineering Co., electrical and general engineers, 71, Parliament Street, Nottingham) have dissolved partnership.

Mr. J. M'Nab Hunter has retired from the firm of Osborne and Hunter, electrical contractors and engineers, 108A, West Regent Street, Glasgow, and the business will be continued under the same title by the remaining partners, Hugh Osborne and J. W. Black. Mr. Hunter has retired owing to certain interests in South Africa demanding his presence there.

The Cross Electric Engineering and Manufacturing Co., Ltd., is winding-up voluntarily.

A final dividend of 3s. in the £ is payable on December 12th, in *re* Harry South & Co., Ltd, of Garrick Street.

A dividend of 20s. in the £ is payable on December 4th in *re* F. W Parkes, electrical engineer and fitter, Colwyn Bay (separate estate). A first and final of 2s. 7d. is payable on the same date in *re* F. W. Parkes and E. Sadleir, trading as Parkes & Sadleir, electrical engineers and fitters, Colwyn Bay.

A meeting of the Never-Wet Seat Co., Ltd., is to be held at Manchester, on January 12th, to hear an account of the winding up by the liquidator, Mr. Geo. Roberts.

Under a compulsory winding-up order made last March against the Automatic Telephone Co., Ltd., a sitting of the London Bankruptcy Court was held last Monday before Mr. Registrar Hood, for the public examination of Mr. Max Margowski, the managing director. The proceedings were based on the petition of shareholders, and accounts have been lodged showing liabilities £1,175, against assets valued at £4,185, but a deficiency of £10,051, as regards shareholders. Mr. H. Brougham, Official Receiver, conducted the examination for the Board of Trade; Mr. Harry Dobb was briefed for the committee of shareholders, and Dr. Counsel for the witnesses.

Questioned by the Official Receiver, Mr. Margowski said the company was registered in January, 1903, and was a reconstruction of the Automatic Telephone Co., Ltd. The last named company was formed in July, 1897, and was a reconstruction of the Apostoloff Automatic Telephone Parent Syndicate, Ltd., which was formed in November, 1895, to acquire an undeveloped invention belonging to Mr. Apostoloff. Of the £10,000 capital of the syndicate, about £4,000 was subscribed in cash, witness providing 98 per cent. of that sum. The capital of the Automatic Telephone Co., Ltd., was £100,000, divided into 400,000 shares of 5s. each, of which 40,000 were issued to Mr. Seligman Lui as the purchase consideration for his patents. In all, 337,662 shares of that company were issued. The witness was questioned at some length regarding 2,000 preference shares standing in the name of his wife, and the circumstances under which they were acquired. He next admitted that as managing director he had exceptional powers. Early in 1902 the company received a model apparatus from Mr. Seligman Lui, and subsequently another was received, the result being that further capital was required. In December, 1902, resolutions were passed for a voluntary liquidation of the company, which was reconstructed under the name of the Automatic Telephone Co. (1903), Ltd. The nominal capital was kept at £100,000, but it was divided into 800,000 shares of 2s. 6d. each. For every 5s. share of the old company the holders were allotted two shares of the new company, each credited with 2s. paid. As chairman of the extraordinary general meeting witness made a speech, which was reported in the *Statist*. The articles of association of the new company also gave him exceptional powers, and made his position as managing director irremovable. In fact, the whole way through since the promotion of the Apostoloff Syndicate, he had enjoyed absolute powers, and could do things which, in other companies, could only be done by the board. On December 19th, 1902, Mr. Barlow, a shareholder, sent in a notice dissenting from the reconstruction scheme, and subsequently notices of dissent were received from other shareholders, one being the Honduras Banking Co., of which witness was a director, and others being friendly shareholders. A compromise was effected with those dissenting shareholders, and out of a total issue of 564,469 shares of the new company, 212,531 went to them. The examination turned upon the distribution of shares issued to witness, and he then stated that certain plant and machinery were purchased and sent down to premises at London Road, Greenwich, belonging to his wife, but bearing the name of Margo & Co.

The Official Receiver: We have had Margowski, David Binney and Co., and now Margo & Co. Have you any more *aliases?*—Margo is not very far out.

Examination continued: On October 28th, 1903, a resolution was passed to purchase for £950 Mrs. Margowski's share in an improved portable electrical fan.

It transpired that the purchase consideration had taken the shape of a mortgage given over the company's machinery, and that an action in connection therewith was pending. Under those circumstances, the Official Receiver contented himself by obtaining the statement from the debtor that the electrical fan had nothing to do with the automatic telephone patents.

Examination continued: When, in November, 1903, a meeting was called, with a view to a voluntary liquidation and a further reconstruction, witness did not know that certain of the shareholders were anxious to have a compulsory winding-up order. A further meeting was held on February 11th, 1904, it being convened by advertisement only. Some shareholders attended, and the voluntary liquidation resolution was carried by proxies held by himself. A poll was demanded, the notice being in witness's handwriting, and being dated six days before the meeting. The witness was questioned at some length regarding the cheques he had received from the company, and the payments made by him on its behalf. He admitted that he had paid certain cheques into his private banking account, and that his pass-book had been lost in the course of his bankruptcy proceedings.

Mr. Brougham intimated that although the Official Receiver in Bankruptcy had no funds in the witness's estate with which to defray the cost of a banker's copy of the pass-book, he proposed to obtain a copy for the purposes of this inquiry. The inquiry was then adjourned to a date to be fixed after the hearing of the action.

Cryselco Lamps.—We understand that H.M. Postal Telegraphs Department has placed a large contract with Cryselco, Ltd., of Bedford, for low and high voltage lamps. The company are very busy on lamps for the Admiralty, and have also received a contract from the Midland Railway for the supply of lamps for one year (ending December 31st, 1905). The large influx of orders this season has necessitated a further increase of plant at the Kempston Works, at Bedford, and an 80-H.P. Crossley gas engine is being put down.

"Comstick."—Mr. S. W. Cuttriss, of Prudential Buildings, Leeds, forwards us a sample of his well-known commutator lubricant, known as Comstick. This is specially prepared for its purpose, and is claimed to be much more effective than oil, tallow, or vaseline in keeping the commutator in good condition.

Osmium Lamps.—We understand that the General Electric Co., Ltd., of 71, Queen Victoria Street, E.C., has completed arrangements for placing the osmium lamp, invented by Dr. Auer von Welsbach, on the market in this country. The lamp has frequently been described, and we need, therefore, only recall the following facts in brief:—The filament is of osmium, and practically indestructible in normal use; the bulbs do not blacken, and the

candle-power does not fall off materially with age; the light is pure white, and is not much affected by variations of pressure within the normal limits; the inefficiency is from 1·5 to 1·7 watts per candle, according to age. The trouble with the lamp is that it cannot be made for voltages above 100 volts at the utmost, 40 volts being much more suitable; but a number can be run in series. The lamp is similar in size and shape to the ordinary glow-lamp, but costs four or five times as much; however, as a 25-C.P. lamp saves one unit every 20 hours, as compared with the ordinary 100-volt carbon lamp, and lasts far longer, there can be no doubt that where the disadvantage of running in series is not of moment the osmium lamp will do good service. Moreover, the remains of a spent lamp are worth 6d. The greatest care is taken in the manufacture, and the severest tests are applied, to ensure the quality and reliability of the lamps. The G.E.C. are the sole agents in this country.

Catalogues and Lists.—A catalogue of electrical novelties has just been published by Messrs. F. Darton & Co., of 142, St. John Street, E.C., who are doing an increasing business in model motors, dynamos, gas and oil engines, scarf pins, electric clocks, flash lamps, bells, batteries, telephones, medical coils and many other electric novelties.

The Otto Electrical Manufacturing Co., Ltd., of 504, Stockport Road, Longsight, Manchester, have brought out a catalogue of their "Otto" patent arc lamp. A few descriptive notes are given relating to the new principles on which the lamp is constructed. The carbons are side by side and almost vertical, converging at their lower ends at an angle of about 22°. The lower ends of the carbons project into the globe, and between these ends the arc is maintained. The arc is surrounded by a small dome reflector, which protects and increases the steadiness of the arc, at the same time throwing the light downwards. The arc is spread out and held in position by a magnetic device. In regard to the feeding mechanism, the carbons both being inclined are fed gradually downwards by the variation of the voltage across the arc. In trimming the lamp, the carbons are dropped loosely into tubes through the top cover of the lamp, and adjust themselves automatically, thus avoiding lowering of the globe or any part of the lamp. The carbons, it is stated, can be burnt to a short length, and even short broken pieces of carbon can be utilised. It is claimed that with a consumption of about 450 watts a candle-power of 6,000 is obtained.

Messrs. Clarke, Chapman & Co., Ltd., of Gateshead-on-Tyne, have favoured us with one of their handy pocket diaries for 1905. It is one of Letts's, and contains a £1,000 accident insurance coupon. The opening pages give illustrations of the electrical and engineering plant and machinery manufactured by the company, and a list of its many branch offices in this country and abroad.

Messrs. Griffiths Bros. & Co., of Bermondsey, are circulating a new list giving particulars of their "Armacell" insulating varnish, and a note of the results of tests carried out at the Imperial Physical Technical Institute, Charlottenburg.

The General Electric Co., Ltd., have issued new leaflets relating to their "Extra Sec" and "E.C.C." dry batteries, Leclanché cells and charging materials, also a special list of electric radiators.

Pamphlet No. 102 received from the Electrical Co., Ltd., describes their electric lever switch gears for operating lifts; and No. 106 gives prices of their high-voltage lampholders.

A pamphlet giving some comparative tests of various covering materials and "Magnesia," has been received from the Magnesia Coverings, Ltd., of Washington Station, Co. Durham.

The Union Electric Co., Ltd., of Queen Victoria Street, E.C., have sent us an advance copy of the list that they are on the point of issuing, with regard to their "E.V." and "E.V.S." types of enclosed arc lamps. The E.V. lamps are made both single and double enclosed, and of two burning periods, viz., 100 and 300 hours. In each case the remains of the positive carbons are used up when trimming as the negative carbons, thus effecting a saving. With the 300-hour type a special arrangement has been introduced securing a minimum consumption of carbons, and ensuring practically no deposit on the inner globes. The "E.V.S.," or traction type lamp is specially constructed for burning in long series, and for remaining unaffected by instantaneous and large changes in voltage.

LIGHTING AND POWER NOTES.

Ballinasloe.—The joint committee of the district asylum will, on December 14th, appoint a consulting engineer for the carrying out of plans and specifications for buildings, machinery, electrical plant, &c., and to generally advise on improvements, &c. Applications should reach the medical superintendent by December 10th.

Barnstaple.—The T.C. has resolved to allow the electrical engineer (Mr. Hadfield) to receive £50 of the premium of 100 guineas to be paid by pupils at the E.L. works. Only one member opposed the decision.

Barrow.—The T.C. has instructed the borough engineer to prepare the necessary plans for the extension of the electricity works.

Boston.—A L.G.B. inquiry was recently held at the Municipal Buildings, with reference to the application of the T.C. for sanction to borrow £20,000 for the purposes of electric lighting. There was considerable opposition on behalf of the local gas company.

Burgess Hill (Sussex).—An extension of time in which to carry out the E.L. order has been applied for by the U.D.C. A scheme has been formulated and tenders invited for the work, but the Council desires to defer carrying out the scheme owing to the expenditure involved.

Burslem.—A special meeting was held recently, to consider the proposal to ask for a prov. order enabling the Corporation to supply electricity to the Urban District of Tunstall as well as to Burslem. It was stated that the probable cost of Burslem scheme would be £25,000, and that it would cost £5,000 more to supply Tunstall.

Cheltenham.—At a meeting of the T.C., the matter of providing additional traction generating plant for the tramways was under consideration. It was decided that it would be advisable to install a battery and reversible booster for the purpose.

Continental Notes.—Italy.—A company has been formed at Lucques, having for its object the production of electrical energy for lighting purposes and for motive power in the industrial establishments of the district.

Albano.—The Communal Council has decided on the installation of an electric lighting system at Albano and Nemi.

Spain.—An electrical central station is being installed at Jerez de la Frontera for lighting the town. The motive power will be supplied by a waterfall on the River Benamahoma.

Villafranca.—A resident has obtained permission to utilise water-power from the Ituberguita and Eguico-Olaberna streams (Commune of Cegama) for providing electric energy.

Madrid.—A new limited company has been formed, under the name of the "Sociedad de Traccion Eléctrica del Mino," with a capital of 4,000,000 pesetas, with the object of constructing and exploiting an electric tramway from Mondariz to Vigo, utilising the waterfall of Barral for the production of the power necessary.

It is announced that the "Central Electrica de Salduero" will be inaugurated towards the end of the present month.

La Corogne.—The Sociedad Hidroeléctrica del Pindo has built, near this town, two large power stations for producing electric power for carbide and other chemical works, and for lighting.

Barcelona.—A private company has obtained the concession of 200 cb. metres of water from the Elbe, to be employed in the production of electric energy.

Dartford.—The U.D.C. has decided to oppose applications by two syndicates for E.L. powers in the district.

The Board of Trade has granted six months' extension to the company possessing the Strood and Dartford Rural District order, in which to raise their capital for the undertaking.

Devonport.—On December 1st a L.G.B. inquiry was held into the Corporation's application for a loan of £7,958 for addional plant at the electricity works. It was explained that the plant was required for the supply of energy to the Admiralty buildings, which would increase the demand by at least 300 kw. There was no active opposition.

Dudley.—An application is to be made to the L.G.B. for its sanction to the borrowing by the Corporation of a further sum of £21,000, to cover excess of expenditure on old loans, and on account of the expenditure to be incurred for additional boilers, engines, dynamos, cables, and electrical plant at the generating station at Scott Green.

Duero (Mexico).—A hydro-electric power station has just been constructed at a place about 160 km. from the town of Guanajuato (Mexico). The station is for supplying electric power for operating the different mines in the neighbourhood. The hydraulic power available amounts to 8,000 h.p., and this can be considerably increased by utilising the water of the numerous lakes in the district. The central station contains four generating units, each consisting of a three-phase generator of 1,250 kw., supplied by the General Electric Co., and coupled to two turbines. Energy is supplied at 2,300 volts and 60 periods. Two 120-kw. direct-current exciters are also installed. The three-phase current is brought to single-phase transformer groups, each of which has a capacity of 1,080 kw. The energy is transformed to 40,000, 50,000 or 60,000 volts. The transmission line is 160 km. long. The conductors are united at the joints by casings, and are mounted on iron poles. Three metres below the high-tension conductors, are fixed on the same poles, the telephone lines of the installation. The line is divided into four sections, each 40 km. long. In the Guanajuato sub-station, the tension is lowered to 15,000 volts by single-phase transformer groups. In the mining districts of the neighbourhood, the tension is still further reduced to 460 volts for supplying the motors.

Eccles.—The T.C. has received from the L.G.B. sanction for a loan of £550 to defray the cost of erecting arc lamps in the streets.

Edinburgh.—The E.L. Committee of the T.C. has agreed to recommend the magistrates and Council to make application to the Secretary for Scotland for consent to the borrowing of a further sum of £90,000 for capital works under the Edinburgh E.L. Prov. Order of 1891.

Edmonton.—The District Council held another special meeting last Friday to consider the electricity offers received from the North Metropolitan Electric Power Supply Co., Foote and Milne, Ltd., the Industrial Engineering Co., and the National Electric Construction Co., Ltd.. To a motion that the offer of the

first-mentioned company should be accepted, an amendment was proposed in favour of the National Construction Co. Upon a vote being taken, the amendment was defeated by 11 votes to 10. A further amendment was then proposed that the Council should themselves take steps to supply the compulsory area, and this was under discussion, when, by the operation of the standing orders, the meeting was adjourned.

Glasgow.—The Works Committee of the Clyde Navigation Trustees has recommended them to fit up a complete equipment for the production and distribution of electrical energy for working the Clydebank Dock, and that the proposal to take the power from the Clyde Valley Electric Co. is undesirable in view of the whole circumstances of the case.

Gloucester.—The T.C. has resolved to apply for a loan of £15,000 for the provision of additional plant at the electricity works.

Hinckley.—Plans have been passed by the U.D.C. for a new generating station in Nutt's Lane for the Leicestershire and Warwickshire Electric Power Co.

India.—Howrah.—It is contemplated to adopt electric telpherage for handling goods and grain at the new riverside warehouse of the East Indian Railway Co.

Kashmir.—Major de Lotbinière's deputation to Kashmir to advise the Durban, on an electric power scheme for Sirinagar, has already been announced. On his way to Kashmir it is probable that Major de Lotbinière will visit Mussoorie, to advise the municipal board on a scheme for the introduction of electric lighting and water supply.

Leigh.—A L.G.B. inquiry was held on November 29th concerning the Council's application for sanction to borrow £16,000 for electricity works extensions.

Leith.—The E.L. Committee of the T.C. has approved of the plans of the additions to the electric power station. The cost is estimated at between £7,000 and £8,000, and there will be installed a 1,000-H.P. engine and new boilers.

Lewisham.—The B.C. has decided to make claims amounting to £1,143 against various companies, for re-instating roads and footpaths broken open during the quarter. The above sum includes a claim for £634 against the South Metropolitan Electric Light and Power Co.

London.—Marylebone.—The E.L. Supply Committee has decided to oppose the proposed application of the Metropolitan Electric Supply Co. for powers to supply energy in the borough.

The Finance Committee reported that, as it was clearly contemplated by the special Act that the Council should postpone payment of sinking fund for three years, the Committee had decided to ask the L.C.C. to amend their sanction to the £433,800 loan to that end; also, that it be requested to advance £100,000 by the middle of January, 1905, such sum to be repaid by half-yearly equal instalments of principal and interest combined within a period of 42 years.

Poplar.—The Electricity Committee of the B.C. reported that a settlement had been arrived at in respect to an action against the municipality at the suit of the National Electric Construction Co., Ltd., for the recovery of £96 7*s*., the amount of minimum payments in respect of installations on the premises of consumers who have ceased to take energy for lighting purposes.

Paddington.—On Tuesday morning last, at the meeting of the B.C., a letter was read from the Central Electric Supply Co., stating that, as the Council will not consent to the granting of a prov. order to the company, for the supply of electrical energy within the borough, the company had determined not to proceed further in the matter.

Chelsea.—An electrical expert is to be engaged by the B.C. at a fee of 15 guineas, to give an opinion as to whether it would be more economical that a supply for the public baths be generated from a private installation, or that energy should be taken from the Chelsea Electricity Supply Co.

Wandsworth.—Complaints having been received from ratepayers, of the insufficient electric lighting of some of the streets in Tooting supplied from the dust destructor, it has been decided, pending the consideration of the general question, to place Nernst lamps in the streets in question, and to make alterations in the plant at the destructor at an estimated cost of £20.

Shoreditch.—At the Tuesday meeting of the B.C. it was decided to call a conference of the metropolitan B.Cs. and the L.C.C., to consider what steps should be taken in opposing the various power companies' schemes for bulk supply in metropolitan areas.

Bermondsey.—The electrical engineer has reported on the circumstances of the breakdown at the generating station on October 30th.

The Council has expressed its dissatisfaction at the excessive cost incurred in laying cables through the Surrey and Commercial Docks.

Lowestoft.—Owing to the threatened flooding of the electricity works during storms, it has been decided to put down a relief storm-water sewer at an estimated cost of £350.

Lytham.—The B. of T. having intimated its intention of revoking the E.L. order obtained by the U.D.C. in 1900, negotiations have been opened with St. Anne's U.D.C. for a supply of energy in bulk. The Council has also decided, on certain stipulations, to support the application by Messrs. Foote & Milne, Ltd., for a prov. order for electric lighting.

Ludlow.—Mr. William Norton has applied to the T.C. for support to his application for E.L. powers, and a special committee has been appointed to deal with the matter.

Macclesfield.—The advisability of abandoning the E.L. Order obtained in 1901, was discussed by the General Purposes Committee of the T.C. on November 29th, the B. of T. having threatened to revoke the order unless some definite steps were taken to carry it out. It was stated that the order, which cost £237 13s. 5d. to obtain, contained no transfer clause, and was, therefore, not a saleable asset. By a large majority, it was decided to recommend the Corporation to take up an E.L. scheme forthwith.

Mexico.—A newly-formed company is about to install a central electric station at Mazatlan.

Mid-Sussex.—The Hayward's Heath Electric Supply Co. has informed the local authorities that it does not intend applying for a prov. order for electric lighting this year. The Hayward's Heath Council is applying for its own order.

Montrose.—The T.C. has accepted an invitation from the directors of the North of Scotland Electric Light and Power Co., Ltd., to inspect their Montrose electricity works and appliances on Wedneeday, 14th inst.

Newport (Mon.).—On Tuesday last week, owing to a shortage of feed water from the public main, the fires under some of the boilers at the electric power station had to be put out, and there was in consequence a failure in the supply of energy for traction and power purposes, and also for lighting in some parts of the town. The failure lasted from about 12 noon to 1.15 p.m.

Ormskirk.—The L.G.B. has intimated that notwithstanding the objections of the U.D.C., the Board will issue an order authorising the Guardians to proceed with the E.L. works at the workhouse.

Sunderland.—The River Wear Commission has decided to take a supply of electricity from the Sunderland Corporation E.L. department for three years.

Sydney (N.S.W.).—The City Council has agreed that a Bill shall be preferred, to enable the Council to borrow a further sum of £250,000 for extending the E.L. plant, &c.

Tewkesbury.—A special meeting of the T.C. has been held at which the resolution to seek a prov. order for electric lighting was confirmed.

Wanstead.—At a meeting of the U.D.C. letters from the Empire Electric Lighting Co. and two other companies, stating their intention to proceed for prov. orders for the district were considered. It was decided to oppose the applications.

Wednesbury.—Application is to be made to the L.G.B. for sanction to a loan of £1,000, for necessary extensions of the cables in connection with the electric light undertaking.

West Bromwich.—The General Purposes Commiteee of the T.C. has had under consideration a report from the Electricity Committee respecting complaints brought against the chairman of the Electricity Committee. The matter was eventually settled, the Committee recommending that the engineer should in future be held responsible for the absolute control of the works.

Willesden.—The Works Committee has advised the Electrical Committee to consider the advisability of adopting flat rates of charging for electric supply in place of the existing maximum demand system.

Wirral.—The Guardians have decided to carry out certain improvements at their workhouse, at Clatterbridge, including a new laundry, with appliances for washing, pumping and electric lighting, at an estimated cost of £2,193.

Wrexham.—At a meeting of the T.C. on November 30th, the Electricity Supply Committee recommended the adoption of a hire-purchase system of wiring for the E.L., whereby installations could be made by the Corporation (or by contractors at the option of the customer), and the total cost, with interest at 5 per cent. per annum, be paid by the consumer in eight equal quarterly instalments if the estimated cost does not exceed £20, the payments being further extended in proportion to the total cost. This is with the object of inducing householders to adopt the E.L. without the heavy immediate cost of wiring, &c. The recommendation was adopted.

TRAMWAY AND RAILWAY NOTES.

Ashton-under-Lyne.—The Corporation and the O. A. and Hyde Electric Tramway Co. have concluded a renewal of the agreement by which the Corporation supplies the whole of the energy for working the tramway for 14 years, commencing next July. The company use over 800,000 units per annum, and we understand that they have recently expressed their entire satisfaction with the supply given them by the Corporation during the past six years.

Birmingham.—In the original scheme for street widenings necessary for the new tramway scheme recently published, it was not anticipated that Dale End would require to be widened, but the Committee now finds that it would be an advantage to have this done under the proposed Bill before Parliament. The cost of street widenings is, therefore, increased to £202,200.

It was stated by the chairman of the Tramways Committee that the Corporation's approval of the style of car was necessary before the Birmingham and Midland Tramways Co., Ltd., could expect the Corporation to buy them over on expiration of lease.

It is anticipated that the Small Heath route will be ready for use early in January.

A breakdown has occurred on the Dudley to Birmingham section of the Midland Tramways Co.'s recently opened line, and the steam cars have had to be put on again.

The electric cars are now running on the recently inspected routes in Aston-Manor with through connections to Birmingham.

Bury.—The Ramsbottom tramway scheme was again under consideration at last week's Council meeting, and a recommendation that power should be sought to construct lines from Tottington, by way of Greenmount, as an alternative route, was agreed to. The cost of the overhead equipment of lines inside the borough boundaries was reported to have been about £13,800.

Cheshire.—The Cheshire Light Railways, Ltd., and their engineer, Mr. R. H. Scotter, have a scheme for connecting Warrington and Knutsford and the rich intervening country by means of a light railway, which is to be run along the side of the Knutsford Road. This line will cut the Ship Canal at Latchford, and the Northwich Light Railway will do so at Stockton Heath. It is thought that the line will be a great convenience to farmers and to the towns concerned, who have long felt the need of means of inter-communication.

Continental Notes.—The company owning the extensive tramway system known as the Vanves-Malakoff and extensions, and operating a considerable stretch of track in the south-west of Paris, equipped with the Diatto surface contact system, has just been declared bankrupt. Several other lines operated on the Diatto system in and around Paris are in a very poor financial position.

St. Germain, a popular suburban resort of Parisians, is to have a light railway or inter-urban tramway connecting it with Maison Laffitte, a well-known racing centre close to Paris, and Argenteuil, a few miles further on. The total length of track will be about 20 miles.

The Renard train, consisting of a motor-car with several trailers, each trailer being operated by means of electric motors mounted thereon and supplied from the generator carried by the leading car, is now carrying out a series of trials on the roads between Dieppe and Rouen.

The returns of the Paris Metropolitan Railway Co. since the opening of the new (No. 3) line have been enormously increased. The new line, forming about a quarter of the entire length of lines in service, has a length of five miles, and has been open for passengers since October 17th. The daily average number of passengers carried was formerly about 260,000, but since the opening of the new line the average has increased to over 420,000 per day, with receipts averaging 72,000 fr. Since January 1st of the present year, the system has carried over 100,000,000 passengers, or over 11 million more than in the corresponding period of 1903.

The Rapid Transit Co., of Philadelphia, has recently sent a deputation of engineers to Europe, which has examined in great detail the Paris surface contact systems of traction. Various surface lines in Philadelphia are unsuitable for the conduit system, and it appears that the trolley line is not looked on with favour for the same districts. Surface contact systems, if practicable, have been proposed, hence the visit of the engineers to Paris.

The Swiss Government has reported favourably upon a scheme for a line uniting Berne with Brig, a town in the Rhone Valley. Several schemes have been under consideration and examination by Swiss engineers, but the Bayeler project has now been definitely approved. The line will have a length of 116 kilometres. The line will be supplied with current generated from the natural hydraulic resources of the country.

A scheme for uniting Genoa and Tortona by an electric railway, including a tunnel 20 kilometres in length, is now under consideration by the Italian Government. The total length of the line is about 50 kilometres, and the total cost is estimated at 77,000,000 francs, of which 6 millions represents the cost of the electric installation. A hydro-electric station of 3,500 H.P. is provided for, to be installed at the entrance to the tunnel. The average grade through the tunnel will be 8 per cent.

The construction of a large dam, destined to retain 10 million cubic meters of water from the River Serchio, has been commenced at Barbellino. The dam will have a height of 40 metres. By two falls of 300 and 500 metres, 16,000 H.P. will be obtained for distribution, during 10 working hours, to the many industries in the district. The cost of the work is estimated to be 1,500,000 lire.

The *Zeitschrift für Elektrotechnik* publishes the following information regarding the Gruyère Electric Railway, Switzerland:—The system (46·6 km.) includes the three lines, Palézieux-Châtel, St. Denis-Bulle-Montbrun. Electric energy is supplied, under the form of three-phase current at a pressure of 8,000 volts, by the Montbrun hydro-electric power station, or, in cases of emergency, from the Hauterive station. These two stations give a total power of 10,000 H.P. Three of the sub-stations contain each two groups of converters, each of a power of 90 KW.; the two other sub-stations contain each two converters of 170 KW. In the five sub-stations mentioned the alternating current is first reduced to 500 volts, and afterwards converted to continuous current of 750 to 1,000 volts. The trolley wire, 9 mm., is of hard copper. The compensating battery, consisting of 375 cells, has a capacity of 115 ampere-hours. The feeders are installed on special poles 8 m. above the ground. There are at present 10 motor-cars in service. Eight of them carries four motors, each of 35 H.P., and making 350 r.p.m. The motor-cars of the first type haul passenger trains of 47 tons at a speed of 20 km. an hour, or goods trains of 60 tons at a lower speed; those of the second type haul trains of 130 tons at a speed of 17 km. per hour. The motors of the smaller model are grouped in pairs connected in series, so that each is submitted to half the regular pressure (375 volts). The electrical machinery was supplied by the Société Alioth, of Bale.

Cricklewood.—Last Saturday the Metropolitan Electric Tramways, Ltd., opened for public traffic another extension of their electric tramways. The new line, which is about five miles long, and has double track throughout, runs from Cricklewood to Edgware. The electricity for working this line is supplied from the large generating station of the North Metropolitan Electric Power Supply Co., at Willesden.

The new line has been constructed by the Middlesex County Council, acting with the Metropolitan Co. The fare for the entire distance is 3d., with intermediate 1d. and 2d. stages. The speed laid down by the Board of Trade regulations varies from 12 to 14 miles an hour.

Halesowen.—The U.D.C. has decided to apply to the Board of Trade for an extension of the orders secured in 1901 and 1902, under which it has the power to commence and complete the construction of tramways in the district, for a period of 12 months from December 18th. The Council some time ago leased its powers for the construction of light railways and the supply of electricity to the Empire Electric Lighting Co., but considerable dissatisfaction exists in the district owing to the fact that the period specified in the agreement expired about two months ago, and no definite action has been taken by the company.

Handsworth.—Last week Sir C. S. Moncrieff continued the arbitration which is to settle the price the Handsworth D.C. shall pay for the portion of the undertaking of the City of Birmingham Tramways, running from the Aston borough boundary to the terminus at Perry Barr, and what rolling stock the Council shall purchase. Evidence was given by Mr. G. Conaty (manager), Mr. A. H. Dickinson (consulting engineer of the tramway company), and Mr. Robert Green (civil engineer), as to the initial cost and depreciation of the rails, concrete bedding, granite pavement, and rolling stock. Mr. Conaty said there was a special demand for old tram rails for colliery purposes, and he had sold them as high as £4 per ton. The bedding might have given way in one or two places, but the concrete was as sound as ever.

Liverpool.—The Tramways Committee has adopted a recommendation of the general manager, Mr. C. R. Bellamy, that the city engineer be instructed to prepare plans and estimates for doubling the electric car track in Church Road, Wavertree.

Ottawa.—A proposal is on foot for the city to buy over the Ottawa Electric Railway system, and expert advice is to be obtained.

South Australian Railways.—In further reference to the report of Mr. F. E. Bradford, on the electrification of the Adelaide suburban railways, the Australian *Electrical Record* says that this shows that electric traction applied to the line to Glenelg and the Port Adelaide, Semaphore and Largs Bay line, besides paying interest on the cost of conversion, would result in an increase of the present profit by £8,912, or a total profit of 3·8 per cent. Mr. Bradford thinks the present traffic would be increased by 25 per cent., but taking 10 per cent. as a conservative estimate, the increase on the present profit would be £17,000, or 7 per cent. on the capital. The services would be more frequent and faster than at present, and the mileage would be 50 per cent. more. He bases his estimates on one power house at Port Adelaide for electric railways and tramways. The cost of supplying the power would be 25 per cent. greater.

TELEGRAPH AND TELEPHONE NOTES.

The Cable to Iceland.—Mr. Koefoo, the Great Northern Co.'s electrical engineer, of Copenhagen, has recently been in Lerwick for the purpose of examining the most suitable spots in Shetland for landing the shore end of the cable.

Pollak-Virag Telegraphy.—The *Daily News* says that to-day a demonstration will be held at the Carlton Hotel of the working of the Pollak-Virag high-speed telegraphic apparatus.

New Dutch Cable.—Reuter reports that the Second Chamber of the States General at The Hague on Saturday ratified the convention with France for the laying of a submarine cable between Saigon and Pontianak in connection with the Dutch cable from Pontianak to Batavia.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1)	Aug. 26, 1901	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
Reissa-Issa (Yemen)-Camaran	Oct. 22, 1902	
Tarifa-Tangier	Jan. 18, 1904	
Closed { Vladivostock-Nagasaki	Feb. 9, 1904	
Closed { Port Arthur-Chefu	Mar. 9, 1904	
Swakopmund-Mossamedes (under repair)	Oct. 10, 1904	
Nassau-Jupiter Inlet	Oct. 20, 1904	
Mozambique-Majunga	Nov. 15, 1904	Dec. 2
Santa Cruz de Teneriffe-Tejita	Nov. 11, 1904	Nov. 26
Paramaribo-Cayenne	July 13, 1904	
Sitka-Valdez	Nov. 11, 1904	
Caimanera-Santiago	June 15, 1904	Dec. 2
St. Thomas-St. Kitts	—	Nov. 28
Landlines.		
Cartagena-Baranquilla	Dec. 8, 1900	
Puerto-Barrios	July 28, 1902	
via Bhamo beyond Tingyuch	Oct. 15, 1904	
Kertch-Soutehoum	Sept. 27, 1904	
Rome-Pera	Nov. 28, 1904	Nov. 29
Rome-Constantinople	Nov. 25, 1904	Nov. 26

Wireless Telegraphy.—It is stated that the wireless telegraph station at Bari (Italy) last week received 400 words from Poldhu (Cornwall) in half an hour. "The experiments are being continued with very satisfactory results."

According to the *St. James's Gazette*, a Madrid professor has made successful experiments in wireless telephony at a distance of about one mile.

The *Standard* states that a contract for the establishment of two wireless telegraph stations has been signed with a German firm. The stations are to be one in the Island of Rhodes and the other at Dernoh, on the east coast of Tripoli, and are to be in working order on May 1st.

CONTRACTS OPEN AND CLOSED.

OPEN.

Belgium.—December 14th. The Belgian State Railway Authorities at La Bourse, Brussels, are inviting tenders until the 14th inst. for the supply of 239,000 metres of arc lamp carbons.

Cardiff.—December 19th. Two slow-speed vertical engines, and 1,100-KW. three-phase alternators; four Lancashire boilers, piping, switchboard gallery, three-phase cables, &c., for the Corporation. See "Official Notices" December 2nd.

Edinburgh.—December 14th. Electric lighting installation for the Branch Free Library. See "Official Notices" November 25th.

Glasgow.—December 22nd. The Corporation is inviting tenders for the supply of 100 electric car motor equipments and spare parts for same. Specification on application to Mr. James Dalrymple, general manager, 102, Renfield Street, Glasgow.

Great Western Railway.—January 3rd. Conductor rails, insulating supports, copper bonds, &c., for the electrical equipment of the Hammersmith and City Railway. See "Official Notices" to-day.

Johannesburg.—December 27th. Transformer pillars and switchgear; also two 35-ton electric overhead travelling cranes, for the Municipal Council's electrical undertaking. See two "Official Notices" October 28th.

London.—December 10th. Tender for 12-ton, 40-ft. span electric travelling crane, with drawings and specification to B. E. Nightingale, Albert Works, Albert Embankment, S.E.

Manchester Ship Canal.—December 22nd. Switchboards, mains, feeders, arc lamps, &c., for the new dock works at Salford. See "Official Notices" December 2nd.

Mexico.—New central electric station at Mazatlan. Offers for electrical equipment to be addressed to Senor José H. Rico, Mazatlan, Mexico.

Middlesbrough.—December 17th. Pipe-work and valves for the Electricity Committee. See "Official Notices" December 2nd.

Pontefract.—December 10th. The Guardians want tenders for extensions to the installation of electric light at the new workhouse buildings. Tenders to T. J. Amies, Clerk to the Guardians, at the Poor Law Offices, Pontefract, by 10 o'clock to-morrow.

Rochdale.—December 27th. Three-phase and continuous-current switchgear, for electricity works extensions. See "Official Notices" to-day.

Roumania.—January 28th, 1905. Tenders are being invited by the municipal authorities of Guirgin for the concession for the electric lighting of the town.

Shanghai.—March 31st, 1905. Construction and working of 24 miles of electric tramways on the trolley system, double or single. See "Official Notices" October 14th.

Southend-on-Sea.—December 21st. Two boilers, steam dynamo, fuel economiser and two electrical feed-pumps, for the Corporation. See "Official Notices" December 2nd.

Spain.—December 12th. The Municipal Authorities of Salamanca, are inviting tenders until December 12th, for the concession for the electric lighting of the town during a period of 10 years. Particulars may be obtained from El Secretario del Ayuntamiento de Salamanca, to whom tenders are to be sent.

Spain.—December 12th. The Spanish Post and Telegraph Authorities in Madrid, are inviting tenders until December 12th, for the establishment and working of a telephone exchange in the town of Talavera de la Reina (Toledo province). Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Correos y Telegrafos, Carretas, 10, Madrid.

Spain.—December 26th. The Municipal Authorities of Valladolid are inviting tenders until the 26th inst. for the concession for the electric lighting of the town during a period of six years. Tenders are to be sent to El Secretario del Ayuntamiento, Maison Consistoriale, Valladolid, whence particulars may be obtained.

Spain.—December 24th. The *Gaceta de Madrid*, of November 24th contains a notice calling for tenders for the public lighting by electricity of Villanueva y Geltru for a term of 10 years. For particulars see above paper.

Stoke-upon-Trent Union.—December 14th. The Guardians want tenders for electric lighting of workhouse premises. Specification and form of tender upon deposit or £2 2s., which will be returned. Tenders to C. Daniel, Clerk to the Guardians, Union Offices, Stoke-upon-Trent, by 9 a.m., December 14th next, sealed and endorsed "Electric Lighting."

Swindon.—December 20th. One 300-KW. or 400-KW. steam dynamo, for the Corporation. See "Official Notices" December 2nd.

West Ham.—Fan engine and "Sirocco" fan, steel chimney, condenser, tanks, hot well, and piping for the electricity department. See "Official Notices" December 2nd.

CLOSED.

Belfast.—At the meeting of the Corporation on 2nd inst. the Committee charged with the receipt of tenders for the electrification of the tramway system recommended the acceptance of tenders to the amount of £538,000. After considerable discussion it was decided to give the whole contract to Messrs. J. G. White & Co., London, on the condition that the engines be built by Messrs. Combe, Barbour & Combe, Ltd., Belfast.

Durban.—The Tudor Storage Battery Syndicate have received a contract to supply a large storage battery and complete booster equipment for the Durban Corporation, S.A. The battery, which will operate in conjunction with tramway generating plant, will consist of 250 cells, capable of giving 770 amperes for one hour. The booster will be made by the Lancashire Dynamo and Motor Co., Ltd.

Earsdon.—The U.D.C. has accepted the tender of the Northern Counties Electric Supply Co. for the supply of E.L. plant at £339 16*s.* 3*d.*

Erith.—For wiring the offices of the Pupil Teachers' Centre for the Education Committee, the following tenders were received :—

	Wood casing.	Steel tubing.
F. A. Glover & Co., Ltd., Clerkenwell (accepted)	£38 0 0	£43 0 0
Tilley Bros., London	64 16 0	69 6 0
Heap & Co., Manchester	130 0 0	160 0 0
Lea, Son & Co., Shrewsbury	61 18 6	75 7 6
Woodville Electric Co., Belvedere	58 15 5	66 18 8
Jackson Bros., Plaistow, E.	92 7 0	99 18 0
W. Dickinson, Bexley Heath	49 10 0	54 0 0
Ward Bros., London	59 0 0	71 10 0
Phillippson & Blois, Forest Gate	52 0 0	55 0 0
S. W. Gibson & Co., Dartford	78 10 0	75 0 0
Hooper, Neary & Co., Greenwich	72 3 0	77 8 0
G. A. Moore, Belvedere	53 10 0	48 10 0
Strange, Sons & Co., Tonbridge	76 0 0	88 0 0
E. Jelley & Co., Maidenhead	80 0 0	87 0 0

Fulham.—The Board of Guardians has placed an order with Messrs. Thompson Ritchie & Co. for electric appliances for the new operating room.

Southwold.—The Hart Accumulator Co., Ltd., have received the order to supply 110 of their standard lighting type cells, to replace the existing battery at the electricity works here.

Torquay.—The T.C. has accepted the tender of the Alphons Custodis Chimney Construction Co., for the erection of the chimney shaft at the power station, at £3,719

Wolstanton and Burslem.—The Guardians last week considered tenders for the provision of an electric light installation at the Chell Workhouse. The following tenders, amounting altogether to £2,587 14s. 10d., were accepted:—

Boilers, Stirling Boiler Co.	£550
Engines and dynamos, Messrs. McClure & Whitfield ..	764
Switchboard, the Electric & Ordnance Accessories Co. ..	194
Wiring, Mr. E. M. Evans	644
Accumulators, Pfluger Batteries Co.	297
Arc lighting, Messrs. Crompton & Co.	148

FORTHCOMING EVENTS.

Friday, December 9th.—At 8 p.m. Physical Society. Prof. S. P. Thompson "On a Rapid Method of Approximate Harmonic Analysis." Mr. W. Duddell on "A High Frequency Alternator." Exhibition of Experiments to show the Retardation of the Signalling Current on 3,500 miles of the Pacific cable between Vancouver and Fanning Island. Exhibit of Ayrton-Mather Galvanometers, Universal Shunts, and Electrostatic Instruments.

At 8 p.m. Electro-Harmonic Society. Smoking concert.

Saturday, December 10th.—At 3 p.m. Junior Institution of Engineers will visit the International Gas Exhibition at Earl's Court.

At 7.30 p.m. Annual Mess Dinner of the Electrical Engineers R.E. Volunteers at Anderton's Hotel, Fleet Street, E.C.

Monday, December 12th.—Institution of Mechanical Engineers. "Gas Engine Testing," by Mr. A. C. Hess.

Tuesday, December 13th.—At 7.30 p.m. Institution of Electrical Engineers (Manchester Section). Mr. L. Andrews will read a paper on "High Tension Switchgear."

At 8 p.m. Institution of Electrical Engineers (Glasgow). Messrs. J. B. Henderson and J. S. Nicholson on "Armature Reaction in Alternators."

Wednesday, December 14th.—At 7.30 p.m. Institution of Electrical Engineers (Birmingham). "Stand-by Charges and Motor Load Development," by Mr. A. M. Taylor.

At 8 p.m. Society of Arts. Mr. Chas. D. Abel on "The Patent Laws."

Thursday, December 15th.—At 8 p.m. The Institution of Electrical Engineers. If the discussion on Mr. Searle's paper, "Studies in Magnetic Testing" is concluded, the following paper will be read:—"The Combination of Dust Destructors and Electricity Works, Economically considered," by Mr. W. P. Adams, Member.

At 8 p.m. Rugby Engineering Society. Discussion on "Premium System *v.* Piece Work System."

Friday, December 16th.—At 7.30 p.m. Institution of Electrical Engineers (Manchester). Mr. E. D. S. Shelmerdine on "The Working of Batteries Under Reversible Booster Control."

THE ELECTRICAL VOLUNTEERS.

The following are the orders for next week:—

Monday, December 12th.—"A" Company: Recruits' drill, 6 p.m. Technical instruction, 7 p.m.

Tuesday, December 13th.—"B" Company: Recruits' drill, 6 p.m. Technical instruction, 7 p.m. Medical inspection for recruits and Special Service Section, 7 p.m.

Wednesday, December 14th.—Instructional drill, Westminster Hall, 8 p.m. Plain clothes; rifles without slings. Submarine mining class, 6—9 p.m.

Thursday, December 15th.—"C" Company: Recruits' drill, 6 p.m. Technical instruction, 7 p.m.

Friday, December 16th.—"D" Company: Recruits' drill, 6 p.m. Technical instruction, 7 p.m. Lecture by the Adjutant, 8 p.m.

Saturday, December 17th.—Week-end class.

WILFRED C. DUMBLE, Capt. R.E.,
For O.C.E.E.R.E. (V.).

NOTES.

South African Notes (from our Durban correspondent).—*Durban (Natal).*—The borough electrical engineer recently pointed out the necessity for providing additional plant to meet demands during certain hours of the day. After careful consideration, he recommended the installation of a storage battery in connection with the tramway plant, and submitted to his committee tenders obtained by him whilst in England. The committee recommended approval of the suggestion, and that the tender of the Tudor Battery Co. be accepted for £3,512 (including erection). This price does not include freight or the cost of housing the battery, which items will, it is estimated, bring the total cost up to £5,000. The expenditure has been approved by the Council.

The report of Mr. Hanson, the municipal telephone manager, showed that 16 new connections had been made, bringing the total number of subscribers to date to 944. During the month tubing and wiring for 100 subscribers' offices for the new system had been carried out.

Pietermaritzburg (Natal).—The tramway manager reports the necessity of having four more cars, which it is hoped to cable for shortly; this will make 16 cars in all. An extra quarter of a mile of single track will shortly be added, into the Park, and it is suggested to also lay one mile of single track from the present terminus at Retief Street to Willow Bridge, also an extension of a few hundred yards from Victoria Road to the Agricultural Society's show ground. The receipts from the day of opening give a total of £468 for 5½ days. The 3d. stage from the railway station to the Town Hall is to be divided into three 1d. stages, which, it is hoped, will encourage the short-distance traveller.

Harrismith (O.R.C.).—The Council has been inviting applications for the post of borough electrical engineer at a salary of £360 per year.

Pretoria (Transvaal).—A special meeting of the Town Council was held on November 11th, when it was agreed to purchase the electric lighting company's works for £115,000, payable in debentures at 5 per cent., and to borrow £20,000 for the purpose of electric light extensions.

Electricity in Mines.—At Wigan, on Friday evening last, Mr. Alfred J. Tonge, of the Hulton Collieries, addressed a meeting of the Manchester district branch of the National Association of Colliery Managers, on the new electricity rules formulated by the Home Office. He said that when the Departmental Committee sat, about two years ago, doubts existed as to the extent to which electricity should be used in mines. Few managers had up to that time used current for other purposes than signalling and surface lighting, and fears were entertained lest some very stringent rules might be adopted. The Departmental Committee in their report, or introduction to the rules, did not discourage, but actually accepted the usefulness, and showed the way to the possibilities, of electricity if properly installed and regulated at collieries. If he might say so, they had given the report from the right hand, but the rules from the left hand were more unyielding and harsh. Still, on the whole, the spirit of the report prevailed, and not the spirit of restriction. There were different courses, Mr. Tonge went on to say, that the Committee might have followed in setting out these rules. They might have gone so far as to restrict the use of electricity entirely in some mines whilst allowing it, if under strict rules, in others; or there might have been total prohibition in all the so-called unsafe mines and any haphazard installation allowed in those mines so-called safe. They had not done either of those things, but had, so to speak, devoted their attention in the rules to raising the standard of electrical work and ensuring that proper precautions were taken in laying down installations. In the report, the difference between a bad installation and a good one was said to be only a matter of about 20 per cent. in money; and bad work, the Committee said, was always occasioning far more loss than this initial saving. The question as to where it was safe to apply electricity, or whether any mine was fiery or unsafe, had been left in the hands of managers, the rules simply saying in so many words:—"You (the manager) are the judge as to where electricity should be taken; but whether you take it into good or indifferent mines, you must put down a good installation." According to the report, and in many of the rules, this idea had prevailed; but Mr. Tonge was of opinion that, whilst this policy might be right, the effect of the rules, as they stood, would be to discourage the use of electricity with those managers who had not so far adopted it, whilst stereotyping certain methods of work which might eventually prove to be inferior. He considered that the following conditions ought to obtain in rules that were to be of the utmost benefit to the mining community:—They should be (1) as few as was reasonably possible; (2) they should be intelligible and free from ambiguity; (3) they should be general rather than specific in terms; (4) they should follow one another in proper sequence, and be properly sectioned; and (5) they should be in keeping in spirit and form with the C.M.R.A. Mr. Tonge then examined some of the electricity rules in the light of these conditions.

Royal Institution.—The following are the lecture arrangements at the Royal Institution before Easter:—Prof. W. E. Dalby, two lectures on "Engineering"; Prof. R. Meldola, two lectures on "Synthetic Chemistry" (experimental); Prof. J. J. Thomson, three lectures on "Electrical Properties of Radioactive Substances"; and three lectures by Lord Rayleigh on "Some Controverted Questions of Optics." The Friday evening meetings will begin on January 20th, when a discourse will be delivered by Prof. Sir James Dewar on "New Low Temperature Phenomena"; succeeding discourses will probably be given by Chevalier G. Marconi, Prof. J. J. Thomson, Prof. G. H. Bryan, the Rt. Hon. Lord Rayleigh and other gentlemen.

Lead Accumulator Plates.—It is known that when lead accumulator plates are formed in the usual way with lead peroxide, they gradually deteriorate in quality, and after a time they cannot be charged to their full extent in one operation. This is apparently due to the fact that the lead sponge loses its state of fine sub-division, and can no longer be easily converted into peroxide. R. Goetze, of Berlin, has taken out a German patent for a process which is claimed to overcome this difficulty. It consists in soaking the layer of lead sponge in a solution which, after the solvent has evaporated, leaves a salt finely distributed over the plate. Suitable salts are the sulphate, phosphate, borate, and silicate of a metal (preferably zinc) which is not thrown out of solution by lead.

A Process for the Electrolytic Recovery of Metals.—An American patent has been assigned by F. von Kügelgen and H. Danneel, to the Willson Aluminium Co., of New York, for a process of obtaining a metal, an alkali hydroxide, and chlorine, by the electrolysis of an alkali chloride. A metallic oxide is introduced into the cathode compartment of an electrolytic cell which contains the chloride of an alkali metal. The latter is decomposed by the current, and the alkali metal which is reduced attacks the metallic oxide, being converted into an alkali oxide (hydroxide), and yielding the other metal in the elemental state. The chlorine and the alkali hydroxide are removed from the cell at intervals, and the strength of the electrolyte is replenished by adding fresh chloride to the anode compartment. As an example, tin oxide may be reduced to metal in a bath of sodium chloride, sodium hydroxide being also formed.

(*Continued on page* 951.)

PIETERMARITZBURG (NATAL) ELECTRIC LIGHTING AND TRAMWAYS.

[FROM OUR DURBAN CORRESPONDENT.]

Pietermaritzburg, or to use the native name, "Umgungunhlovu," signifying "Chief City," is the seat of the Legislative Assembly of Natal, and until recently was the chief garrison town of the Colony. Its population at the recent census was 15,086 whites, and 16,113 Indians, natives, &c., and like most Colonial towns, it has a large municipal area. The town proper, where electric light cables are laid, is confined to an area of 2½ sq. miles, and being laid out in squares with wide streets is admirably suited for electric traction. The suburbs, as yet, are not reckoned as being within the electric lighting area. It may be here noted that unlike other South African towns, Pietermaritzburg stands unique, in that all its cables are laid underground.

General View of the Power Station.

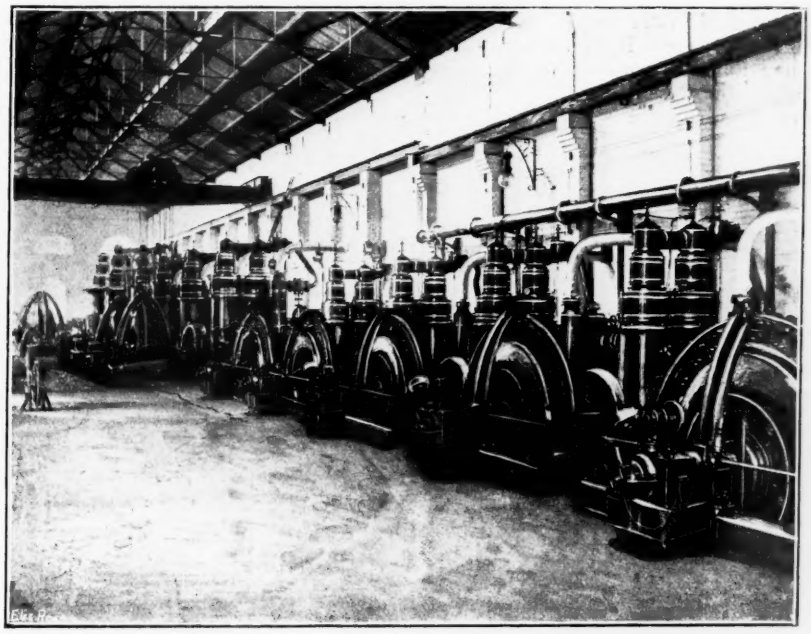
The early days of electric lighting in Pietermaritzburg were associated with many troubles; Messrs. Woodhouse and Rawson had at that time a 36-kw. rope-driven A.C. generator set at work in the Town Hall, which supplied current for lighting the latter. On the appointment of the present borough electrical engineer (Mr. Skidmore Ashby) in 1895, this plant was taken over, and by way of encouraging a load, some 4½ miles of high-tension overhead mains were run from the Town Hall for the supply of about 30 consumers. The success of this venture led to the initiation of the present scheme; the first set—a 60-kw. Willans Mordey alternator which supplied 49 consumers, the price then being 1s. per unit—was erected on the present site in July, 1898.

This is near the railway, and 1½ miles from the centre of the town. The station buildings consist of boiler and engine rooms, switch room, test room, stores, workshop and offices; adjoining them is the car-shed, &c., now in course of erection. A view of the power station buildings may be seen in our illustration; two iron chimney stacks are arranged for, one at either end, the second stack being now in course of erection.

The boiler room is 195 ft. long × 35 ft. wide, and so arranged that it can be doubled with but slight alteration. The boiler plant was supplied by Messrs. Hornsby, of Grantham, and there are installed eight boilers of 85 h.p., and four of 210 h.p. each, ten of these being hand fired; also two of 390 h.p. each, of the "upright" type, and fitted with coking stokers, by Messrs. Hodgkinson, of Manchester. Two of the 210-h.p. boilers are similarly fitted, and provision has been allowed for a further 800 h.p. extension.

The boilers work at a pressure of 120 lbs. per sq. in., and are fitted with dead weight and other safety valves, high steam and low water alarms, "Klinger" water gauges, &c.

The steam-pipe range is by Messrs. Stewart & Lloyd, and practically consists of one steam pipe from each boiler to the corresponding engine, all such pipes being coupled together by an equalising range, having parallel-slide valves fitted between each pair of boilers. There are also the usual expansion bends at intervals in addition to expansion rollers fitted under the foot of the steam drums of the various boilers.



View of Alternating Plant in the Engine Room.

The pump room adjoining the boiler house contains three compound tandem feed pumps of the "Weir" type, each with a capacity of 5,000 gallons of water per hour, and two service

pumps of similar type, each with a capacity of 50,000 gallons per hour, for supplying water for the condensers. A wrought-steel ring feed main is provided to the boilers; the pump suctions are supplied with hot water under a 3-ft. head, the water being heated by the exhaust steam from the pumps, which is passed through a feed heater, and by the drains from the steam traps of the separators fitted to each engine; also to a small extent through the whole of the feed water being first passed through the cooling pipes, in the crank chambers of the Willans engines.

The feed-water supply is in duplicate from the town mains, and a storage tank is provided of 150 tons capacity. This supply goes through a regulating tank and a McDougal filter into the hot tanks, from which the Weir pumps draw their feed.

An ash tunnel runs below the firing floor in front of the boilers, and suitable openings in the floor are provided so that the ashes can be raked into tip trucks below; these are, by means of an electric elevator at the end of the tunnel, elevated and emptied into railway trucks or carts as may be desired.

The engine room is 195 ft. long × 35 ft. wide, and is spanned by a 10-ton hand travelling crane. There are 10 lighting sets consisting of Mordey alternators, generating current at 2,000 volts, direct-coupled to Willans & Robinson's two-crank compound engines, with exciters, of the open field, two-pole type, mounted direct on the shaft. There are also two 500-volt direct-current four-pole traction sets by the same makers, and ample room is provided for future extensions. The various units, which were supplied by the Brush Electrical Engineering Co., Ltd., consist of six 60-KW. alternators, two 120-KW. alternators, two 240-KW. alternators, and two 120-KW. D.C. traction generators.

The six 60-KW. sets and the four 120-KW. sets exhaust into "Ledward" ejector condensers, a separate condenser being provided for each engine.

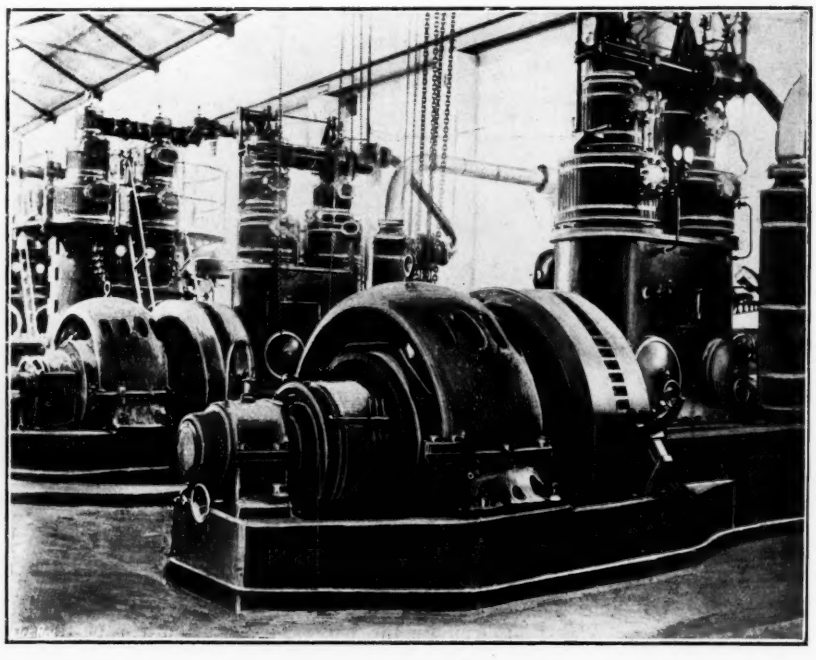
The two 240-KW. sets discharge into a surface condenser, which is combined with a motor-driven Edwards air pump. Two motors are provided to the pump, for direct and alternating current respectively, either being capable of taking the whole load.

The traction and lighting switchboards are arranged in a separate switch-room leading from the engine room by a staircase. In the switch-room is also fitted a test table containing Elliott instruments for insulation, capacity, copper resistance tests, &c.

The traction switchboard is of the well-known Ferranti

CAR-SHED—PIETERMARITZBURG.

TYPICAL TRAMCAR—PIETERMARITZBURG.



WILLANS-BRUSH TRACTION GENERATORS.

cellular make, and consists of four generator and five feeder panels, fitted with magnetic blow-out switches, &c. On the regulating board immediately below, there is a parallel voltmeter switch for each machine, equaliser switches, and D.P. field-break switches. Each machine panel is also fitted with a Ferranti patent reverse current relay, for cutting out any faulty machine.

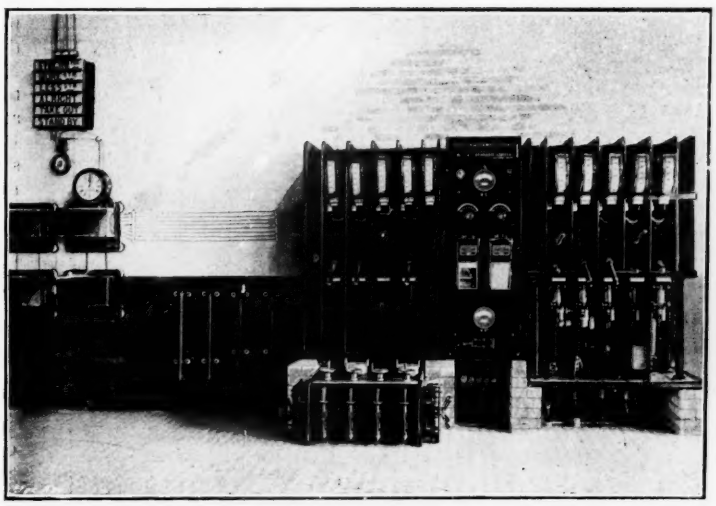
Five feeder panels are similarly fitted, and provided also with lightning arresters and choke coils.

The lighting switchboards are two in number, the original one, supplied by the Brush Electrical Engineering Co., being at the opposite end of the switch-room to the traction board, and the other, supplied by Messrs. Ferranti, occupying a portion of the side wall, both boards being connected through switches to a common bus-bar. The Ferranti board has four machine panels, which are connected to the two 240-KW. and two 120-KW. sets. The synchronising arrangements are in duplicate, and a "hospital" bus-bar is also provided with inter-connecting switch, by means of which any machine may be run separately.

The "Brush" board consists of six machine panels, to which are connected the six 60-kw. sets, and six feeder panels. In this board, the machine and feeder panels are fitted with "Andrews" patent reverse and excess current automatic cut-out switches and other instruments of normal type. The various rheostats are arranged in a room immediately below the switch room, the handles for controlling these being fixed in front of their respective machine panels.

The signalling arrangements from the switch-room to engine room are the design of the electrical engineer, and were made locally. On the left of the traction board is an indicator board, divided into various partitions, any one of which can be illuminated from either switchboard by pressing various keys.

This indicator board is in parallel with three others placed at intervals along the engine room wall, and one at least is in full view from every engine. A system of bells is worked in conjunction with the indicators, by means of which the driver is also enabled to signal to the switch-room. As a guide to the driver in synchronising, the alternating arc lamps by which the engine room is lighted, enable him to observe, by means of white lines painted on the back alternator pole projections, when synchronous speed is attained. The meter and arc lamp testing, also mechanician and photometer rooms, are below the switch-room, and are very completely equipped. Large offices adjoin the engine room for the accommodation of the engineering and commercial staffs.



Ferranti Traction Switchboard, and Engine Room Signal Gear.

The car-shed is 70 ft. long and 105 ft. wide, built of brick, with an open front, and divided into three bays, each containing three tracks; it can accommodate 18 cars.

The cables along the main route are laid under the pavement in a conduit with a brick bottom and sides, the covering stone forming part of the pavement, which can easily be lifted at any time. The conduit is drained at intervals into the common town drainage system. The cables are laid side by side in uniform order, on bricks placed edgewise along the conduit, about 3 ft. apart, and are thus easily accessible for repairs or additions, while in the side streets the cables are laid direct. There are two tramway "trunk" mains, each 1½ miles long, which run to a distributing sub-station at the Town Hall, and distribute by seven feeders to the various switch-boxes. There are also two other feeders into two switch-boxes between the power station and the Town Hall, making a total length of 5·8 miles of feeders, in addition to the three miles of "trunk" mains; these were manufactured by the Callender Cable and Construction Co., and are of the paper-insulated type.

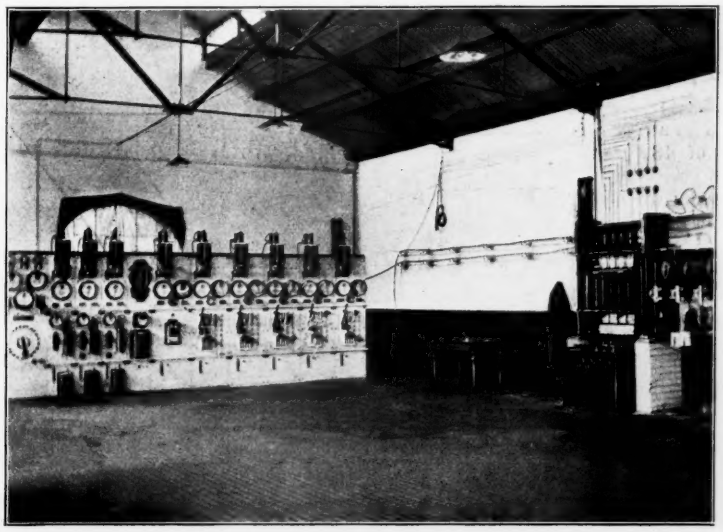
The trolley wire is double throughout, of 000 S.W.G., and is double insulated, flexibly suspended, and supported chiefly from centre double-bracket poles at a height of 22 ft. 6 in.

The trolley lines are divided into ½-mile sections, and are fed in the centre of each section by 19/14 feeders, from 10 switch-boxes.

No guard wires are necessary, on account of the telegraph department placing their wires underground when crossing tramway routes.

In the event of changing the position of the present arc lamps to the tramway poles, every alternate pole has been arranged to carry the necessary cradle and leads.

The track is laid down to a gauge of 4 ft. 8½ in.; 4 miles are constructed with "girder" section rails weighing 94 lbs. to the yard, and fitted with sole-plates composed of 2-ft. lengths of similar girder rail bolted under the rail ends at every joint, and 3 miles are constructed with "Vignoles" rails, weighing 65 lbs. per yard, making a total length of 6 miles of single track, and 1 mile double. The girder rails are laid on concrete stringers, with granite setts on both sides of each rail, and the "Vignoles" rails are laid on creosoted sleepers. The points and crossings are of Hadfield's manganese steel; the joints being bonded with 00 S.W.G. "Neptune" bonds, and every length of rail is cross bonded with one 0000 S.W.G. bond—all poles being bonded to the rails.



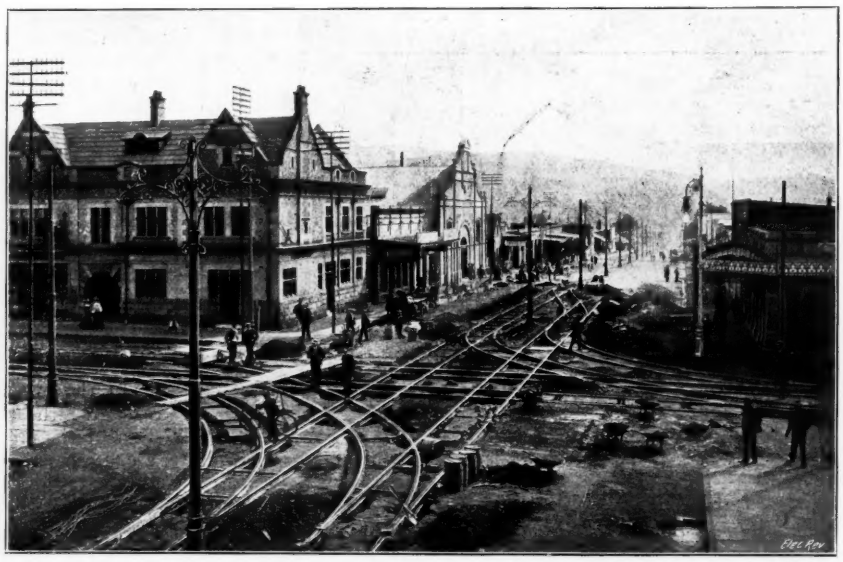
View of Brush and Ferranti Lighting Switchboards.

The overhead equipment was supplied by Messrs. Blackwell & Co., London, and the construction of the track and overhead work has been carried out by Messrs. Strong & Moore, of Durban. The line runs through the two principal streets, and out to the suburbs of Scottsville in one direction, while in the other direction work is proceeding with the Botanical Garden route.

Ultimately, there will be 12 cars and one sprinkler; six cars have already arrived, and these are of the Brush Electrical Engineering Co.'s make of the double-deck reverse stairway type, mounted on maximum traction trucks, with a seating capacity of 63 passengers.

The car is suitably arranged for local climatic conditions, the top deck being partially enclosed with wooden canopy wind screens to which doors are hinged, and the sides

provided with roller blinds. The interior of the car is divided transversely by a sliding glazed partition for the accommodation of smokers if necessary, and Heywood's double revolving chairs are arranged in pairs on either side of the centre gangway, a parcel rack also being provided along each side.



Special Track Work, Town Hall Crossing.

Messrs. Brecknell, Munro & Rogers's swivelling type trolley is fitted, the cord terminating in a Wilson trolley cord catcher.

The motors, two in number, are of the British Westinghouse Co.'s make, each 30 H.P., and are controlled by series-parallel Westinghouse controllers of the "Railway" type. There is the usual hand and rheostatic brake, also an emergency brake which short-circuits the motors. The other six cars on order from the Brush Electrical Engineering Co. are of the double-deck type, mounted on four-wheel trucks with a wheel base of 6 ft. 6 in., fitted with B.T.H. equipment, and have a total seating accommodation of 48 passengers.

The sprinkler is mounted on maximum traction trucks, provided with Westinghouse equipment, and has a capacity of 3,000 gallons. It also is fitted with rheostatic, Sterling hand and magnetic track brakes.

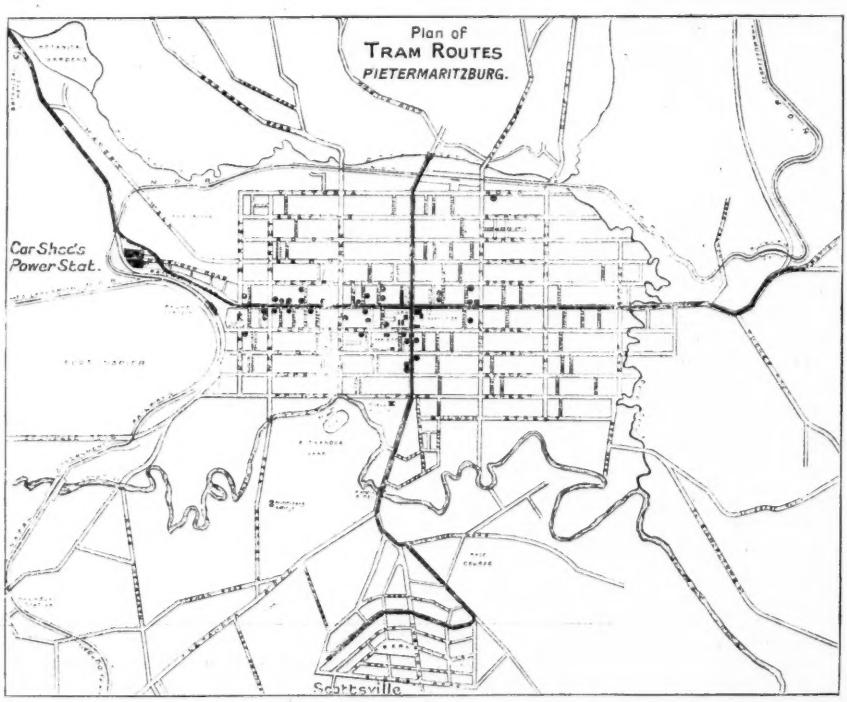
A 10-minute service of cars will be run in the centre of the town and a 30-minute service in the suburbs, the fares being 3d., or 2d. by coupon, per stage.

The lighting of the four principal streets is effected by 91 Brush Vienna 14-hour alternating arc lamps, arranged alternately on each side of the street, and giving very effective results. The lamps are fed from small Brush self-choking transformers, giving 15 amperes each, with a ratio from 2,000 to 32 volts, the transformer being placed in the base of each pole.

These are fed off separate H.T. distributors, which are connected to the main feeder through special switch boxes. The boxes are provided with a special door, front and back, under lock and key, the front door giving access to the H.T. switches and fuses, and the back door to the cords, by means of which the police are enabled to operate each group of lamps. The average price obtained for street lighting is 6·028d. per unit, which price includes all capital charges, trimming, maintenance, generation and distribution of current. There are seven H.T. feeders for the private lighting, chiefly of the Helsby Telegraph Manufacturing Co.'s make, totalling about 9 miles, and including 1½ miles of Henley's paper cable, the sizes ranging from 19/14 to 19/16.

The H.T. distributors total about 8¾ miles, the sizes ranging from 7/14 to 7/20, and are of the Helsby Co.'s manufacture. Each H.T. cable feeds a H.T. distributor for five or more transformer pits, situated in each of the transverse streets, each pit having a capacity for two 24-KW. transformers. Each set of transformers supplies one complete block of buildings on either side, the L.T. network being independent of any other.

As the increased demand in any section necessitates an alteration, sub-stations built above ground are being substituted for the transformer pits, in which switching arrangements will be provided for cutting out idle transformers during the period of light load. There are some 23 miles of L.T. distributors manufactured by the Telegraph Manufacturing Co. of the armoured concentric rubber class, 19/14 and 19/16 in sizes, also 4 miles of B.I.W. paper-insulated cable. All house-service joints off the paper cables, are made in a box which is filled in with compound, and in the case of the rubber cables, all joints are vulcanised. There are six sub-stations above ground; the one at the



Plan of Tramway Routes and Supply Area.

Town Hall comprises a two-storey building, with traction, H. and L.T. switchgear above, and transformers below, space being available for six 50-KW. transformers and one spare. The tramway distribution switchboard is of the Ferranti make; the two trunk mains from the power station are connected to it, also seven distributors. The trunk mains are fitted with reverse-current cut-outs here, as well as at the station, by means of which any faulty feeder is immediately disconnected.

Telephone cables of the Callender make, connect each feeder box and the chief sub-station with the power station, and potential wires are laid from the terminus of each trunk main to the Board of Trade panel. In conjunction with the Town Hall sub-station, there is a motor-generator of 45 B.H.P. The motor is supplied with alternating current at 200 volts from the sub-station transformers, and the generator gives a 100-volt D.C. supply. In the day-time it is run to charge a battery of 56 Tudor cells of 3,600 ampere-hours capacity, which are in an adjoining room, and at night supply the Town Hall. This arrangement takes off the peak of the load at night, besides giving a duplicate supply for the Town Hall lighting, as well as a steady day load.

The wiring of houses is under the supervision of an inspecting electrician; the meters are of various makes, and are chiefly Ferranti and Westinghouse watt-hour-meters.

The charge for lighting is 9d. and 6d. per unit, based on the "maximum demand," and the average price obtained is 7·569d. The charge for motors is from 2d. to 4d. per unit, and it is interesting to note the figures of the year 1903, in which 792 consumers, with 24,635 8-C.P. lamps were connected, and 742,190 units sold.

The motor-load is supplied entirely by alternating current, Langdon-Davies motors being chiefly used for sizes under 6 H.P., while for larger motors the Heyland type predominates; at present there are 44 consumers connected, representing 236 H.P. The record station-load is 465 KW. with a load-factor of 20 per cent., and the cost per unit, including interest and depreciation, equals 6·773d.; 12·2 lbs. of Natal coal being used per unit generated.

The whole of the installation has been done departmentally; Messrs. Mordey & Dawbarn, of London, acted as consulting engineers, Mr. S. Ashby is the borough electrical engineer, with Mr. A. S. Munro as assistant, while Mr. P. Finlayson is tramway manager; and, in concluding, we must express our indebtedness to Mr. Ashby for his courtesy in allowing our representative to view the works, and for the information he so readily gave.

NOTES.

(*Continued from page* 946.)

Mond Gas.—A large number of the members of the Junior Institution of Engineers, accompanied by the President, Mr. W. H. Lindley, and the chairman, Mr. Samuel Cutler, jun., availed themselves of the recent opportunity for visiting the central station of the South Staffordshire Mond Gas (Power and Heating) Co. at Dudley Port. They were received by the managing director, Mr. Howell; the resident engineer, Mr. Lindop; and other gentlemen. Mr. H. A. Humphrey, the company's consulting engineer, was prevented at the last moment from being present. The station, the first as yet erected, occupies a position which is practically the industrial centre of gravity of the district, comprising 120 sq. miles in South Staffordshire, over which the company have powers. There are to be four units, each of eight producers, and the first unit, together with a complete set of spare towers, is now ready for working. Each producer is capable of gasifying one ton of fuel per hour throughout the day and night. The coal elevators, storage bunkers, producers, superheaters, gas mains, mechanical washers and towers; the lead acid towers for sulphate of ammonia; and the cooling towers were all examined with much interest. Steam is raised by means of climax vertical boilers arranged for burning small coal with forced draught, and also for firing by gas. Fraser & Chalmer's compressors for putting the gas under pressure for distribution were seen in the machinery house, and two vertical Westinghouse gas engine sets, driving various electric motors used in connection with the plant and for lighting. The pipes for conveying the gas to Wolverhampton, Walsall, and intermediate towns have been laid by Messrs. John Aird & Sons, and are mostly of the steel-locking type made by Mephan Fergusson.

The Finsen Memorial.—A movement is on foot for establishing an international memorial to Prof. Finsen, of lupus-light cure fame. Their Majesties the King and Queen have subscribed to the fund.

Specific Heat of Superheated Steam.—According to Carpenter, the specific heat of superheated steam increases with the pressure, but does not vary with the increase of temperature so long as the pressure remains constant. He gives the following values:—

Absolute pressure.	Specific heat.
14·7 lbs.	0·484
20·0 „	0·492
40·0 „	0·523
60·0 „	0·553
80·0 „	0·563
100·0 „	0·614
120·0 „	0·645

The figures may, he says, be expressed as an equation, in which P = the absolute pressure, and K = specific heat. This equation is as follows:—K = 0·462 + 0·001525 P. Thus, the value of the specific heat at 180 lbs. absolute, would be 0·7165. While the above table shows that the specific heat increases with the pressure, there is nothing to show that the increase of the temperature corresponding to the pressure increase had nothing to do with the increase of the specific heat.

Society of Arts.—On Wednesday evening a paper on "The International Exhibition at St. Louis, U.S.A.," was read by Mr. W. F. Reid, F.I.C., F.C.S.

Northampton Institute.—The annual prize distribution takes place to-night. Lord Reay will present the prizes and certificates at 8 o'clock. To-morrow evening, from 6.30 to 11 o'clock, the members' and students' conversazione will be held.

Trials of Electrical Vehicles in France.—The trials of electrical motor vehicles which are being organised by the French daily, *L'Auto*, are to be held in May next, and will consist of eight daily runs of 100 kilometres in Paris and suburbs, the vehicles returning each evening to the charging station. There will be three categories as follows:—(1) Two-seated cars of a total weight in running order, of not more than 1,300 kilogs.; (2) Four-seated cars of a maximum weight of 1,500 kilogs.; and (3) Six-seated vehicles with capacity for 30 kilogs. of luggage per passenger, and of a maximum weight of 1,800 kilogs. The cars may have open, closed, or convertible bodies; they must have a sprag, and at least one double-acting brake. The object of the trials is to decide the merits of the cars for town and suburban use, and the points to be taken into account are the cost of up-keep per day for the distance run, the relative comfort, silence, and ease of control of the cars, and their cost.

Northern Electrical Contractors' Meeting.—The sectional meeting of delegates of the Incorporated Association of Electrical Contractors, was held at the Queen's Hotel, Stockton, on Saturday, Mr. T. MacDermott, J.P. (Manchester), presiding. The representatives of local associations present included Messrs. Cross, Robson, Usher and Andrews (Newcastle), Hirst (Leeds), Taylor (Huddersfield), Harford (Liverpool), Steinthal and Shaw (Manchester), Brown (Sunderland), Tattersall (Middlesbrough), Geipel and Prescott (West Hartlepool), Watson (Stockton), and W. Cross (hon. sec.). Various matters of interest to the trade were discussed, and it was decided to hold the next sectional meeting at Manchester in February.

Royal Society.—Among the papers down for reading yesterday were the following:—

Sir Oliver Lodge, F.R.S., "Note on a Means of Producing a High-Voltage Continuous or 'Pertinacious' Current."

Sir James Dewar, F.R.S., and R. A. Hadfield, "The Effect of Liquid Air Temperatures on the Mechanical and other Properties of Iron and its Alloys."

On Wednesday last week the Society held its annual meeting at Burlington House, Sir W. Huggins presiding. The president delivered his annual address, reviewing the work of the Society during the past year, and the medals were afterwards presented to Sir W. Crookes, Prof. Ernest Rutherford, Prof. Burnside, Colonel D. Bruce, Prof. W. H. Perkin, Mr. W. Bateson, Prof. Cantor of Halle, and Sir J. W. Swan. In the evening the annual dinner was held.

Railway Electrification.—On Tuesday evening, in addressing the students of the Great Eastern Railway Mechanics' Institution Evening Classes, Lord Claud Hamilton, chairman of the Great Eastern Railway, said that he hoped the students would give their close attention to the study of electricity, because we were still in our infancy in regard to the knowledge of electricity and its future power and influence over the world. He added that the Great Eastern Railway Co. was not a rich company, and could not afford to spend money in experiments that would most likely prove to be unremunerative. While they congratulated the Lancashire and Yorkshire Railway on what they had done in the direction of electrical traction, he felt that, judged by present experience, those experiments would not prove remunerative.

Gas.—It is reported that a large number of deaths have occurred in New York—21 in the course of a week—the public gas supply having poisoned the victims. It is said that altogether 300 deaths are attributed to the same cause.

An explosion and fire at the Mill Hill gas works of the North Middlesex Gas Co., on Sunday, caused a failure of gas supply over a very large district. As the public lighting of the district is wholly dependent upon gas, the district was in complete darkness.

Lectures.—Sir W. H. Preece—"late Comptroller of the Postal Telegraph Department," a Hampshire paper describes him—delivered a lecture on "Imperial and International Communications," before the Winchester Literary and Scientific Society on Monday last.

On the same day Sir Oliver Lodge delivered a lecture before the Automobile and Cycle Engineers' Institute, on "Ignition," and described his new method, in which condensers are interposed in the high voltage circuit.

Appointments Vacant.—An assistant is wanted for the electrical engineering department of the Central Technical College, Exhibition Road (£150); electrical distributing assistant for Belfast (£200); young electrical engineer (as improver) at Peterborough electricity works (20s.); shift engineer for Horsham (£100); assistant engineer (£100) and others for Bridlington electricity department.

Sun Spots and Magnetic Storms.—At a recent meeting of the British Astronomical Association, Mr. E. Walter Maunder described some inquiries he had been engaged upon regarding the connection between spots on the sun and magnetic disturbances on the earth. He said, though he was satisfied that there was a general agreement between the appearance of spots and of storms, especially when only big spots and big storms were taken into account, yet he could not get that agreement to go far enough when all the disturbances were taken into consideration. When examining the Greenwich records for the 20 years 1882-1901, he noticed that in many cases the disturbances occurred at a mean interval of 27⅓ days, the apparent period of the sun's rotation, and he then began to compute the longitudes of the centre of the sun's disk at the time of the beginning of the disturbances. This led him to the discovery that of 276 storms one-third were arranged in pairs equal to one rotation of the sun, while three-quarters showed a rotational period in one form or another. The inference was that the cause of the storms was in the sun, and rotated with it, and that the disturbances arose from certain definite areas of the sun. Further, it was clear that the influence did not radiate from the sun in every direction like light, but travelled along definite stream lines, which excited a storm on the earth if the latter was in the path of the stream, but had no effect if it was not. This hypothesis suggested a new view of solar activity, and further involved the corollary that there must be an approach to structure of some sort in the sun, and that it was not at the present time a homogeneous mass.

London County Council.—At the meeting on Tuesday, the Council decided to sanction the borrowing by the Shoreditch Borough Council of £1,255 for street electric lighting purposes. The Education Committee obtained the approval of the Council to the lighting by electricity of the higher grade school now being built in Mina Road, Walworth, and to the supply of current to the premises by the Southwark Council at a flat rate of 4d. per unit.

The Highways Committee reported that in view of the magnitude of the tramway undertaking, it was desirable to standardise the various parts and details of the rolling stock and plant, so that in the event of repairs being necessary, or spare parts required, the work might be done without difficulty, and in the most economical way. Before further orders for materials were given, the Committee thought that standard samples and patterns should be prepared of all the various parts of the rolling stock, &c., in order to secure the advantages of uniformity in design and construction. It was particularly important to have a full range of specifications, drawings and patterns, covering every detail, and by possessing its own patterns, the Council would be able to have castings supplied direct from the foundry, and finished in the Council's own workshops. The cost of preparing the drawings, patterns and data for standardisation would be about £350, and the Committee obtained authority for the expenditure of this amount.

Among the sections contained in the Council's General Powers Bill, the Parliamentary Committee reported that Part XV. proposes to authorise the council of any Metropolitan borough authorised to supply electrical energy, to wire and fit the premises of consumers.

McMillan Memorial Fund.—We are informed that as the result of Mr. W. H. Patchell's appeal for contributions to the above fund after the annual dinner of the Institution on Thursday evening last, a sum of about £120 was immediately collected, and has been placed to the credit of the fund, while some £16 more is promised. It is intended to keep this appeal open for a few days more, to enable members and friends to send in any further contributions. To bring up the fund to the total amount of £2,000, which it has always been hoped to realise, the sum required is now only about £65.

Electric Power at the Coliseum.—The Junior Institution of Engineers visited the London Coliseum to inspect the engineering plant in connection with the revolving stage on 3rd inst. The stage is composed of three separate concentric rings, with an overall diameter of 75 ft.; each is built up on a rolled steel underframe, and rotated by stationary electric motors situated underneath. Fourteen motors are utilised for the above purpose, and are controlled from special switch pillars on a raised gallery on the prompt side of the stage, from which all parts are visible. The signalling is carried out by means of a special arrangement of ship's engine-room telegraphs from a signal station on the stage, where also speaking tubes, lamp signals and telephones are provided to the numerous electrical operators stationed near the apparatus. The actual controllers fixed below the stage are stated to be the largest series-parallel controllers made as yet; and through them it is possible to operate in either direction, and at speeds up to 20 miles an hour any of the stages. The installation also includes eight panoramas and a cyclorama, also electrically-driven, and electrically-driven winches are installed for hoisting the scenery proper. In all some 30 motors are to be used, and some 12 miles of cable are run in connection with the various devices. For the lighting cables an earthed steel tube conduit system has been adopted throughout, and about 5,000 8-c.p. incandescent lamps are installed on the stage, together with a further 2,000 in the auditorium. The switchgear is of a very comprehensive character, the board containing 85 switches; the public part of the theatre is supplied by two independent companies, and is separate from the stage supply. Mr. E. Wingfield Bowles has been responsible for the working out of the mechanical and electrical details of the scheme.

Alien Patentees.—A paper was contributed to the weekly meeting of the Coventry Engineering Society, by Mr. T. E. Halford, of London, on the subject of "Patents and Patent Law." Discussing the new legislation providing that the patentees should manufacture the patented article in the United Kingdom to an adequate extent, or grant licences on reasonable terms, he said he thought it would be agreed that this was going back to the statute of James I., which allowed patents to be granted for any manner of new manufactures within the realm, and which never contemplated granting patents to aliens who made their goods abroad, and merely imported them into this country. This working section, he gathered, was inserted owing to pressure being brought to bear upon the Government by a certain Chamber of Commerce, because the industry in which they were chiefly concerned was being injured by unfair foreign competition. Certain non-resident aliens had British patents for certain articles essential to the trade of the district, and our own manufacturers of similar goods found their business killed in two ways. First, the alien patentee dumped the articles, which our manufacturers could produce as cheaply, if not cheaper than the alien, into the English market at under cost price; secondly, the articles for which they held British patents they sold at exorbitant prices, and refused licences to the British makers on any terms, but offered them a small commission if they pushed foreign-made articles. Thus all the profit went abroad, and the commission offered was too paltry to be considered seriously. As our manufacturers holding patents in the alien country had to work their inventions there, it was thought only fair and right that the alien patentee should do the same here, and as the result of this agitation he now had to do so. Mr. Halford considered this was a good point in the new Act, as he failed to see why we should always legislate for the alien, while he, on his part, always legislated against us.

Artificial Diamonds.—In a recent number of the *Western Electrician*, Mr. A. de Courcy has described some of the improvements effected by Prof. Moissan in his original method of making artificial diamonds. In the first experiments, the mass of iron which had been saturated with carbon in the electric furnace was cooled in its crucible by plunging the latter into water; but the vaporisation of the liquid prevented heat from being abstracted from the metal with the rapidity that was desirable, if the expansion of the iron at the moment of its solidification should cause the exertion of sufficient pressure upon the carbon during its separation. Other experiments were, therefore, tried by dropping the crucible containing the carburised iron into a vessel filled with lead maintained at its fusing point. In this case, the iron rose through the lead in the form of drops, for, though viscid at the temperature of the electric furnace, the iron became more fluid as it cooled. The drops were then collected and attacked with nitric acid. The yield of diamonds was better when this method was adopted, some specimens being specially clear and brilliant, and one, having the shape of a triangle with rounded corners, being 0·57 millimetre in diameter. Three months after its formation, this specimen cracked and soon fell into three pieces, in a manner closely resembling that noticed with some natural diamonds from the Cape. In another set of experiments, an iron rod was gradually pushed into the electric furnace as it melted and absorbed carbon, the drops being allowed to fall through water into a bath of mercury. This method of producing the iron shot was very easy to carry out, and although the crystals were very small, they were remarkably regular, and occurred in both the black and the transparent variety. Diamonds of still better quality were obtained by fusing and carburising iron as usual, and then pouring about 400 grammes of it into a 3-centimetre hole drilled in an iron cylinder 14 centimetres in diameter, which was partially submerged in water; the mouth of the hollow cylinder being closed with an iron stopper as quickly as possible. The outer portion of the iron was then turned off in a lathe, and the interior portion treated with acid in the usual way. Some of the crystals produced in this manner were of a very fine quality, and were perfectly transparent. Cooling was even more rapid, and the results correspondingly more favourable, when a similarly constructed cylinder of copper was employed.

Litigation in Tramway Accident Cases.—The recent Assizes at Manchester were prolific of litigation arising out of accidents on the local tramway lines. Two or three of the cases presented unusual features. One, in which a special jury gave damages against the Corporation for £790, was for injury to a commercial traveller, Mr. J. Whiteley Jones, whilst travelling as an outside passenger on one of the Palatine road-cars on August 15th. At Fallowfield the line for some distance is single, with loops at intervals. The car on which the plaintiff was seated was travelling apparently a little faster than it should have done, and overshot one of the loops. The driver attempted to back it, so as to regain the

loop, and to allow another car, coming in the opposite direction, to pass, but without adjusting the trolley pole; the consequence was that the trolley caught on one of the span wires, and the pole was snapped off. It fell on the plaintiff's head and injured him very seriously. Liability was conceded on the part of the Corporation, and the only matter in dispute was as to the amount of compensation. It was stated by several medical gentlemen that the plaintiff (who was too ill to be present in Court) was suffering from traumatic hysteria and neurasthenia, and could not recover under 12 months at the soonest. Counsel for the Corporation were surprised at the amount awarded, and immediately asked for stay of execution, pending an appeal. The Judge said if terms could be arranged he would grant a stay, not otherwise. Ultimately it was arranged that the plaintiff should receive a sum of £450 down, and upon an undertaking being given that the appeal should be expedited as far as possible, the Judge granted a stay for 14 days, the defendants undertaking to pay the plaintiff 4 per cent. interest on the balance, from the date of the trial, in the event of the appeal failing. It was understood that the question of prosecuting the appeal rested with the Tramways Committee, which meets next week. If it is not proceeded with, the damages awarded will at once be paid in full.

The Manchester Corporation was more fortunate in a second case, in which damages were claimed by a married woman for injury sustained, as she said, through the car starting the moment she had put her foot upon the step, and so causing her to fall in the road. Negligence on the part of the car conductor was not proved, and a verdict was given for the Corporation.

The Salford Corporation were defendants in a case in which a greengrocer, named Parker, claimed compensation for personal injuries. The man's cart had been run into by a tramcar of the defendants, and damaged. For this damage the Corporation agreed to compensate him, but afterwards the plaintiff himself, who was riding in the cart at the time of the accident, became the victim of an incurable hernia. The jury awarded him £225.

Rubber Cultivation in the Federated Malay States.—The very high price of Para rubber has occasioned attempts in the direction of rubber cultivation in almost every part of tropical Greater Britain. In the remoter parts of the Far East, namely, the Federated Malay States, considerable attention is being given to the matter. The report of the Resident-General for 1903, which has just been issued in the form of a blue-book, contains some interesting notes on the subject. The exact acreage under Para rubber cultivation is not given, but cultivation is said to be extending rapidly, and most sanguine hopes are entertained as to the prospects of successful rubber cultivation in these States. Export in quantity has not yet commenced, but adequate authorities have reported that the samples grown are equal, if not superior, to the Ceylon-grown product. So favourable does the prospect appear, that additional areas are being brought under cultivation. The one pest that seems likely to threaten the future of the plantations is the *Gestroi* variety of *Termites*. The Government is endeavouring to take steps to assist the planters in coping with it, and the appointment of an entomologist is recommended.

High-Pressure Condensers.—In the *Elektrotechnische Zeitschrift*, Prof. J. Moscicki recently recorded the results of an extensive series of experiments on high-pressure condensers. In the case of the relative losses of apparent energy, $\jmath v = 2\pi f C v^2$, undergone by the condenser being calculated, it is found that with constant frequency, and for a given thickness of glass, these losses increase for increasing pressures. Hence it is inferred that the losses for a given condenser taken absolutely cannot be proportional either to the square of the pressure, as assumed by Steinmetz, or to any lower power of the pressure, as stated by Arno and Threlfall. For the same kind of glass, the relative losses are found to diminish according to a law so far unknown, with constant pressure and frequency, but increasing thickness of glass. The losses in glass condensers will accordingly increase for increasing potential falls. With constant pressure, and given thickness of glass, the relative losses increase for increasing frequency. The total losses in Bohemian glass, such as is used for test tubes, with alternating current of 50 cycles per second, and a pressure of 250,000 volts, are found to be less than 1 per cent. of the apparent energy traversing the condenser. The losses in the glass are found to be due to conduction only to a very small extent (about 2 per cent. of the aggregate) the main source of losses being deformations undergone by the dielectric for variable fields.

Birmingham Tramways.—The T.C. on Wednesday authorised the promotion of a Bill for a tramways development scheme to cost nearly £1,000,000.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the power station or the commercial side of the profession and industry also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*]

Central Station Engineers.—On December 1st, at the Parish Church at Barnes, Mr. Edwin L. Pope, distribution engineer to the L.C.C. tramways, was married to Florence Ada, second daughter to Mr. Charles H. Owles, of Scarth House, Barnes Common. Among the many presents received were included a silver biscuit-box from the head office staff, and a silver cake dish and a tobacco jar from the sub-station staff. The honeymoon is being spent at Bournemouth.

An Australasian contemporary says that Mr. Peter M'Coll, chief engineer of the New Zealand Electrical Syndicate, has been appointed mechanical engineer at the power-house of the Wellington tramways.

Mr. H. Newcomb, of the South London Electric Supply Co., has been appointed shift engineer to the Fulham municipal undertaking.

Mr. J. Ernest Doidge, late resident engineer of Totnes, has been appointed resident engineer of the electricity works of Exmouth, which are now in the course of erection.

Mr. E. Moxon, at present mains superintendent to the Huddersfield Corporation, has been appointed mains assistant to the Blackburn Corporation Electricity Department. There were 80 applicants.

Mr. R. B. Leach, assistant engineer at Aston Manor electricity works, has been appointed assistant electrical engineer to the Farnworth Urban District Council.

Mr. J. Galbraith Westlake, of Peterborough, has been appointed shift engineer at Battersea. There were upwards of 120 applicants.

A special report of the Worcester Electricity Committee stated that Mr. C. J. Sutherland, electrical engineer, had resigned owing to ill-health. Mr. Parker said Mr. Sutherland had been told he could not undertake any more work. The resignation was accepted with regret and expressions of sympathy. The Committee had placed Mr. Birrell in charge of the department for the time being, and asked the Corporation to advertise for a successor to Mr. Sutherland at a salary of £400 per annum, rising by annual increments of £20 to £500. The Committee asked for power to make the appointment, but this the Council declined to grant.

Tramway Officials.—The Bury Town Council last week raised the salary of their tramway manager, Mr. Clough, to £250.

On Thursday, December 1st, the Reading Corporation resolved at once to increase the salary of Mr. Walter Binns, general manager and engineer of the Reading Tramways, from £300 to £400 per annum, rising by two annual increments of £50 to £500 per annum, on condition that he agrees to remain in their service for a period of three years. The resolution was carried by 32 votes to 4 against.

At a meeting of the Glasgow Tramways Sub-Committee, it was agreed that the salary of Mr. James Dalrymple, the tramways manager, should be fixed at £1,000 per year.

Mr. John Metcalf, late manager of the Gateshead and District Tramway Co., is now in the employ of the British Johns-Manville Co., Ltd., electrical engineers, of 81, Fenchurch Street, E.C.

General.—The employés of Messrs. Calvert & Heald, electrical engineers, of Lancaster, have presented a chased silver salver to Mr. Jas. Heald, on his election as Mayor of the borough.

Last week Mr. A. S. Jones, who is retiring from the post of local manager at Burton-on-Trent for the National Telephone Co., was presented by the staff with a walking stick.

Mr. J. Cecil Bull, secretary of the City of London Electric Lighting Co., Ltd., has been elected a Vice-President of the Chartered Institute of Secretaries.

Mr. H. Rudolph has been appointed Chief of Posts and Telegraphs of the Dutch East Indies, *vice* Mr. Berman.

NEW COMPANIES REGISTERED.

Brynamman and District Electric Supply Co., Ltd. (82,705).—This company was registered on November 29th, with a capital of £2,000 in £1 shares, to carry on the business of suppliers of electricity in all its branches, electrical and mechanical engineers, manufacturers of and dealers in electric, magnetic, telegraphic, telephonic, and other apparatus and appliances; steam, hydraulic, pneumatic and other engines, &c. The first subscribers (each with one share) are:—T. W. Ellis, 35 and 36, Wind Street, Swansea, electrical engineer; D. Jones, Nantmelyn Shop, Brynamman, Carmarthenshire, butcher; E. Evans, Brynamman Hotel, Brynamman, Carmarthenshire, hotel proprietor; R. Thomas, Station Road, Brynamman, Carmarthenshire, butcher; J. Rogers, Glyn Road, Brynamman, Carmarthenshire, tin works shearer; E. W. Evans, Cwmgarw Road, Brynamman, Carmarthenshire, clerk; and D. H. Williams, Glyn Road, Brynamman, Carmarthenshire, butcher. No initial public issue. The number of directors is not to be less than four nor more than seven; the first are not named; qualification, £25; remuneration (except managing director), as fixed by the company; none until 5% dividend has been paid. Registered office, Brynamman, Carmarthenshire.

W. W. Bamford, Ltd. (82,727).—This company was registered on November 30th, with a capital of £2,000 in £1 shares, to carry on the business of electrical, mechanical, consulting and practical engineers, manufacturers of and dealers in electric, magnetic, telegraphic, telephonic, and other apparatus and appliances, makers of steam, hydraulic, pneumatic or other engines, meters, dynamos, fuse-boxes, cut-outs, and other appliances, dealers in vulcanised bitumen, damp course cloth, box and sealing compounds, bitumen lapping and tapes, wires, cables, wood and other troughing and bridges, &c. The first subscribers (each with one share) are:—W. W. Bamford, 2, Burch Road, Northfleet, Kent, electrical engineer; Mrs. A. E. Bamford, 2, Burch Road, Northfleet, Kent; Miss E. H. Allingham, 2, Burch Road, Northfleet, Kent; J. Allingham, Woodside, Matlock Bath, retired teacher; Mrs. A. Allingham, Woodside, Matlock Bath; Mrs. M. C. Candelet, Woodside, Matlock Bath; and A. D. Brocklehurst, 36, Chislehurst Street, Cheetham Hill, Manchester, clerk. No initial public issue. The number of directors is not to be less than two nor more than four; the signatories are to appoint the first; qualification, £100. Registered office, Deepwater Pier, Northfleet, Kent.

Gosport and Alverstoke Electric Lighting Co., Ltd. (82,693).—This company was registered on November 28th, with a capital of £5,000 in £10 shares, to supply electric light to towns, streets, markets, theatres, houses, buildings, and other public or private places, and to carry on the business of electricians, manufacturers of electricity for light, heat, motive power or otherwise, manufacturers of and dealers in all apparatus used in connection with the generation, distribution, supply, accumulation and employment, of electricity, &c. The first subscribers (each with one share) are:—W. M. Murphy, J.P., Suffolk House, Laurence Pountney Hill, E.C.; J. B. Glenn, 77, Castleton Road, Tufnell Park, accountant; J. Glenn, Glencaun, Parley, Surrey; A. L. Hoskins, 43, Lesser Avenue, Clapham, S.W., clerk; F. Simpkin, 15, Gloucester Road, Walthamstow, clerk; A. C. Kitts, 1, Churchill Road, N.W., clerk; and G. Bates, 70, Queen's Road, Southend-on-Sea, clerk. No initial issue. The first directors are not named.

Supplies, Ltd. (82,737).—This company was registered on December 1st, with a capital of £5,000 in £1 shares, to carry on the business of electricians, mechanical engineers, producers and suppliers of electricity, motive power and light, &c. The first subscribers (each with one share) are:—J. Atherton, Hurst Park, Prescot, manufacturer; J. B. Atherton, Manhattan, Gateacre, Liverpool, manufacturer; S. A. Atherton, Hurst Park, Prescot, merchant; H. A. Atherton, The Nook, Gateacre, architect; C. E. Ruckley, 15, Brompton Avenue, Egremont, secretary; D. L. Chalmers, 12, St. John's Lane, Liverpool, chartered accountant; and D. Hogg, 47, Aberdeen Street, Liverpool, clerk. No initial public issue. Registered without articles of association. Registered office, 12, St. John's Lane, Liverpool.

H. F. Hill, Ltd. (82,615).—This company was registered on November 19th, with a capital of £100 in 5s. shares, to adopt an agreement with H. F. Hill, to acquire certain patents therein described, and to carry on the business of electricians, mechanical engineers, suppliers of electricity for light, heat, motive power or otherwise, manufacturers of and dealers in electrical apparatus, contractors for tramway, electric railway, and other works, &c. The first subscribers (each with one share) are:—Jessie J. Taylor, 181, Prince of Wales Road, N.W., secretary; Nora C. Brewer, 38, Akerman Road, Brixton, dental assistant; M. J. Rice, 115, Piccadilly, W., valet; H. F. Hill, 116, Piccadilly, W., dental surgeon; I. Darley, Weston Works, Weston Street, W.C., manufacturer; A. Hill, Newstead, Bancroft, Hitchin, dental assistant; and C. S. Hills, 21, Warwick Lane, E.C., tailor. No initial public issue; registered without articles of association.

Nicholson & Robinson, Ltd. (82,651).—This company was registered on November 23rd, with a capital of £2,000 in £1 shares, to carry on the business of electricians, mechanical engineers, contractors, builders, manufacturers of and dealers in electrical apparatus, &c. The first subscribers (each with one share) are:—G. J. T. Alder, 9, Richmond Gardens, W., electrical engineer's manager; W. Webber, 51, Bovill Road, Honor Oak Park, clerk; F. A. S. Werotte, 100, Redcliffe Gardens, S.W., engineer; Mrs. C. Hopkins, Broomhall, Northwood; Mrs. E. N. Nicholson, 93, Gunterstone Road, W.; A. F. Cooke, 5, St. James's Mansions, Muswell Hill, N., electrical engineer; and A. H. F. Fitzherbert, 5, St. James's Mansions, Muswell Hill, W., electrical engineer. No initial public issue. Table "A" mainly applies. Registered office, 53, Victoria Street, Westminster.

Cheshire Light Railways, Ltd. (82,669).—This company was registered on November 25th, with a capital of £1,500 in £1 shares, to obtain from the Light Railway Commissioners or other authority any orders authorising the construction of light railways in Cheshire or elsewhere in the United Kingdom or abroad, to adopt an agreement with R. H. Scotter, and to carry on the business of light railway proprietors, manufacturers of and dealers in railway and tramway carriages, motor cars, omnibuses, locomotives and engines, &c. The first subscribers (each with one share) are:—H. Greenall, High Cliffe, Warrington, solicitor; R. H. Scotter, Salisbury House, E.C., civil engineer; J. Twiss, 117, Wilderspool Causeway, Warrington, building surveyor; E. England, Moss House, Stockton Heath, land and estate agent; J. Coxon, Lumm, Cheshire, manufacturer; A. Bennett, Morningside, Warrington, chartered accountant; and E. J. Hall, Welfield, Stockton Heath, Warrington, chartered secretary. No initial public issue. The number of directors is not to be less than two nor more than five; the first are J. Coxon, H. Greenall and R. H. Scotter; qualification, £25; remuneration, one guinea each per meeting attended.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Kalgoorlie Electric Tramways, Ltd. (73,127).—A trust deed, dated October 14th, 1904 (supplemental to and varying the terms of a deed dated April 21st, 1902, securing £200,000 debenture stock), has been registered. Property charged: The benefit of and money deposited in connection with a certain concession, the benefit of two agreements, and the company's tramways, undertakings, land, buildings, stock, uncalled capital and general assets, present and future. Trustees: Consolidated Trust, Ltd., 4, Throgmorton Avenue, E.C. The supplemental deed varies the rate of interest, and divides stock into £100,000 "A," and £100,000 "B."

Brooker & Goss, Ltd., electrical engineers, &c., Waltham Cross (76,425).—Two debentures, both dated October 31st, 1904, securing £100 and £300 respectively, have been registered. Property charged: The company's undertaking and property, present and future, including unpaid capital. The two debentures rank *pari passu* with each other, and with a prior debenture for £500. Holders: H. V. Esmond, 21, Whitehead's Grove, Chelsea (£100), and G. F. Puxon, 23, Warham Road, Croydon.

South Staffordshire Tramways (Lessee) Co., Ltd. (63,160).—A trust deed, dated November 1st, 1904, to secure £54,700 debenture stock (with power to issue further stock ranking *pari passu* up to a total of £100,000), has been registered. Property charged (specifically): The company's leasehold interest in the South Staffordshire Tramways, certain rights and powers with respect to the working of such tramways, the company's leasehold interests in certain land, buildings, fixed plant and machinery at Wednesbury, Walsall and Dudley, and certain preference shares and ordinary stock in the South Staffordshire Tramways Co. As a floating security: The company's undertaking and remaining property, present and future. Trustees: Law Guarantee and Trust Society, Ltd., 49, Chancery Lane, W.C.

Burnand Transformer Co., Ltd., Manchester (73,049).—£1,000 second debentures, created August 31st, 1904, charged on the company's undertaking and property, present and future, including uncalled capital, subject to £1,000 prior debentures, have been registered. No trustees.

Northampton Electric Light and Power Co., Ltd. (28,640).—Issue on November 5th of a 4 per cent. debenture for £400, part of series created June 3rd, 1896, to secure not more than two-thirds of the subscribed and paid-up capital for the time being, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £32,200.

Electrolytic Alkali Co., Ltd. (64,360).—Issue on October 31st of £1,850 first mortgage debentures, part of series created July 9th, 1904, to secure £50,000, charged on the company's undertaking and property, present and future, including uncalled capital. Trustees: Liverpool Mortgage Insurance Co., Ltd., 6, Castle Street, Liverpool. Previously issued of same series: £10,350.

Underground Electric Railway Co. of London, Ltd. (73,376).—A trust deed dated October 25th, and an instrument of charge under the Land Transfer Acts, 1875 and 1897, bearing same date, to secure £850,000 debentures created by resolution of October 18th, 1904, have been registered. Property charged: The company's generating station, plant and machinery at Lots Road, Chelsea, with cables and ducts therefrom to Earl's Court, the company's interest in certain contracts for the supply of electricity and otherwise, and the loose plant and machinery, tools, implements, fuel, stores, and similar loose chattels belonging to the company in or upon the said generating station or any part thereof. Trustees and holders of charge:—J. Trotter, 2, Princes Street, E.C.; H. Cockburn, 61, Threadneedle Street, E.C.; and J. A. Dawes, 9, Angel Court, E.C.

South African Lighting Association, Ltd., gas and electric (27,609).—Issue on October 26th of £480 and on November 5th of £520 debentures, part of series created August 13th, 1890, to secure £20,000, charged on the company's undertaking and property. No trustees. Previously issued of same series: £20,000.

Kinetic-Swanton Co., Ltd., electrical and general engineers, Lincoln and London (78,688).—A debenture for £150, dated October 31st, 1904, charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. No trustees. Holder: C. Scorer, Lincoln.

Lodge Electric Light and Power Co., Ltd., Liverpool (80,741).—£1,000 debentures, dated October 31st, 1904, charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. Holders: Sir P. E. Bates, 3, New Quay, Liverpool.

Vaughan & Son, Ltd. (61,526).—This company's annual return was filed on September 19th, when 3,595 preference, and 20,689 ordinary shares had been taken up out of a nominal capital of £50,000 in £1 shares (20,000 preference). £24,284 have been received. Mortgages and charges: £5,000.

New St. Helens and District Tramways Co., Ltd. (59,426).—This company's annual return was filed on November 1st, when 15,980 preference, and 9,000 ordinary shares had been taken up out of a nominal capital of £150,000 in 20,000 preference, and 10,000 ordinary shares of £5 each. £5 per share has been called up, and £125,410 has been received, including £510 paid on 1,020 forfeited shares. Mortgages and charges: nil.

Monte Video Telephone Co., Ltd. (27,208).—This company's annual return was filed on November 16th, when 86,492 preference, and 72,680 ordinary shares had been taken up out of a nominal capital of £160,000 in 87,000 preference, and 73,000 ordinary shares of £1 each. £159,172 has been received. Mortgages and charges nil.

Direct West India Cable Co., Ltd. (53,956).—This company's annual return was filed on October 13th, when 12,000 shares had been taken up out of a nominal capital of £120,000 in 24,000 shares of £5 each. £2 10s. per share has been called up, resulting in the receipt of £30,000. Mortgages and charges: £31,800.

Prested Miners' Gas Indicating Electric Lamp Co., Ltd. (76,081).—This company's annual return was filed on November 16th, when 14,600 shares had been taken up out of a nominal capital of £15,000 in £1 shares. 15s. per share has been called up on 5,000, and 10s. per share on 2,100 shares, resulting in the receipt of £4,798 15s., leaving £1 15s. in arrears. 7,500 shares are considered as fully paid. Mortgages and charges: Nil.

Sanitas Electrical Co., Ltd. (72,615).—This company's annual return was filed on October 8th, when 4,250 shares had been taken up out of a nominal capital of £5,000 in £1 shares. £1 per share has been called up on 2,250 shares, resulting in the receipt of £2,250. 2,000 shares are considered as fully paid. Mortgages and charges: Nil.

Notting Hill Electric Lighting Co., Ltd. (25,921).—A trust deed dated November 2nd, 1904, issued jointly by this company and the Kensington and Knightsbridge Electric Lighting Co., Ltd. (supplemental to two trust deeds dated July 12th, 1900, and November 18th, 1902, covering £100,000 and £50,000 respectively, both issued by this company and the said Kensington and Knightsbridge Electric Lighting Co. jointly), to secure a further £50,000 debenture stock, ranking *pari passu* with the two former joint issues, has been registered. Trustees: R. B. Martin, M.P., 68, Lombard Street, E.C.; and G. H. Hopkinson, 93, Pimlico Road, S.W. Property charged: Freehold generating station belonging jointly to this company, and the Kensington and Knightsbridge Electric Lighting Co., Ltd.

Kensington and Knightsbridge Electric Lighting Co., Ltd. (26,193).—A trust deed dated November 2nd, 1904, issued jointly with the Notting Hill Electric Lighting Co., Ltd. (supplemental to a trust deed, dated July 12th, 1900, covering £100,000, and a further trust deed dated November 18th 1902, covering £50,000, both issued jointly by this company, and the Notting Hill Electric Lighting Co., Ltd.), to secure a further £50,000 debenture stock, ranking *pari passu* with the two former joint issues, has been registered. Trustees: R. B. Martin, M.P., 68, Lombard Street, E.C.; and G. H. Hopkinson, 93, Pimlico Road, S.W. Property charged: Freehold generating station belonging jointly to this company and the Notting Hill Electric Lighting Co., Ltd.

Knowlden & Co., Ltd. (electric light fitters, &c., Leicester) (82,409).—A debenture dated November 4th, 1904, to secure £100, charged on the company's undertaking and property, present and future, has been registered. Holder: E. A. Wood, 100, Aston Road, Birmingham.

Thomas Crapper & Co., Ltd. (electrical and general engineers, Chelsea) (82,482).—£4,900 debentures, created 10th and dated November 16th, 1904, charged on the company's undertaking and property, present and future, including uncalled capital (as a floating security) have been registered. Holder: T. Crapper, 12, Thornsett Road, Anerley. No trustees.

Keynsham Electric Light and Power Co., Ltd. (64,634).—Issue on November 9th of £300 debentures, part of series created November 30th, 1903, to secure £1,500, charged on premises at Keynsham and the company's undertaking and property, present and future, including uncalled capital. Holders: E. E. Mills, c/o Capital and Counties Bank, Oxford; and Miss E. J. Mills, 21, Wellington Park, Clifton, Bristol. No trustees. Previously issued of same series: £1,200.

ELECTRICITY SUPPLY ACCOUNTS.

Bradford Municipal Electricity Supply.

The Bradford accounts do not disclose any special evidence of decadence on the part of the electrical undertaking, as one might be led to imagine from local reports, in fact, the results appear to be well up to the average of the previous year. The falling average revenue, under the influence of large power and traction loads, is counterbalanced by improved working costs. Large extensions have, of necessity, been carried out, and financial charges are this year about 80, as compared with 73 per cent. last year, of the gross profit, a matter which will right itself as the capital becomes fully remunerative. The department contributes £9,694 to depreciation out of its available balance, as compared with £8,436 for the year ending December, 1902. The amount carried forward from the last account was £9,360, and we are informed that this item now stands at £10,448.

The prices charged are:—Private lighting, 4d. per unit, with 2½ per cent. discount (free lamps supply); power, 2d. to 1½d. per unit; traction, 1d. per unit; public arcs, £12 10s. per annum. The chief engineer is Mr. A. S. Blackman.

General Statement.

For year ending March 31st—	1904.	Dec. 31st, 1902.
Total capital expended	£534,579	£423,926
Number of units sold—		
Private lighting	2,297,345	1,910,871
Motors	2,704,663	1,900,034
Public lighting...	58,271	54,116
Traction	7,510,339	5,259,202
Total number of units sold ...	12,570,618	9,124,223
Equivalent No. of 8-c.p. lamps connected	—	239,509
H.P. of motors connected	on hire 3,271 / private 2,660	4,398
Number of public lamps	51 arc	51 arc
Maximum load in kw.	light'g 3,450 / tr'ction 2,150	4,977
Revenue account—		
Gross revenue	£88,826	£70,917
„ expenditure	£42,471	£32,356
„ profit	£46,355	£38,561
Average price obtained per unit—		
Private lighting ... ... 3·89d.		
Motors ... ... 1·16d.	= 1·57d.	1·75d.
Public lighting ... ... 2·62d.		
Traction ... ... 1·00d.		

Revenue Account for Year ending March 31st, 1904.

Gross revenue	£88,826 =	1·7d. per unit.
Works and distribution costs (including public lighting)	£26,278 =	·50d. „
Total working costs	£42,471 =	·81d. „

Profit Statement, 1904.

Interest on loans, &c.	£15,700
Sinking fund	20,145
Income-tax and sundry	752
Balance on year's working...	9,758
Gross profit	£46,355

CITY NOTES.

British Aluminium Co.

Mr. J. D. Bonner presided at the extraordinary general meeting held at Winchester House on Monday, and he moved the confirmation of the resolutions passed at the meeting held on November 9th, for the re-arrangement of shares and alteration of articles. This having been agreed to, the chairman proceeded to move the adoption of the other resolutions of which notice appeared in our last issue. He said that at the ordinary general meeting in July, it was explained that owing to the growth of the company's business, the carrying out of the Loch Leven water power scheme should not be longer delayed, and it was promised that proposals for providing the necessary capital, should be made. The outlay involved was large, but notwithstanding that within the last two years £50,000 had been spent upon buildings and plant, very much larger expenditure would be necessary to make the extensions to the works at Larne, Greenock and Milton, which the development of the business demanded. They would require not less than the £490,000 indicated in the resolutions, but obviously the whole of that could not be raised by debentures, a portion must be raised by the issue of shares. In a business like this they could not remain stationary. They would enter upon next year under very different conditions from those now prevailing. They believed that the profits would be sufficient to enable both the 7 per cent. preference shares and the funding certificates to be paid in cash. The extension of the plant at Foyers was now complete, and should be producing at a maximum capacity throughout next year. On the whole, the outlook was very encouraging, and it was their intention to expedite the completion of the Loch Leven scheme. They hoped to let the contract for the works to some well-known firm of contractors very shortly.

Mr. H. Wolfenden seconded the adoption or the resolutions.

A few shareholders having offered certain criticisms, the Chairman replied that unless they increased their capacity of output there was no possibility of dividends being continued on any class of shares for any considerable time. The money already expended upon the Loch Leven scheme approximates to £40,000. They would spare no effort to get the works finished by the end of 1906, because for market purposes they would be requiring aluminium to be produced at them even before that time. The engineers of the scheme were Messrs. Thomas Meik & Sons, engineers, of Westminster. The debentures would be underwritten in the usual way—£75,000 were already underwritten at 4 per cent.

British Westinghouse Electric & Manufacturing Co.

Mr. W. J. Buchanan presided at the fifth annual general meeting held at Hamilton House, E.C., on Tuesday. In moving the adoption of the report, to which extended reference was made in our last issue, he said that what he would have to say would be based upon two or three facts. First, that the formation of the company, and the building of the plant at Trafford Park, was evidently not the result of immature thought on the part of their chairman, nor of his associates, but of their well-considered, careful thought, founded on their experience in like enterprises. Second, that the company was evidently not formed, nor the works built, for the present, or for the next two or five years, but upon what must have been a conscious belief on the part of those who initiated the undertaking, and who still believed in the correctness of their view, that it would not be found too large for the work that would one day come to it—be that day near or far; and, third, upon the knowledge that results secured during the early years of the life of any large industrial enterprise were not conclusive as to what its future would be. Inquiries had been received from shareholders, and to these he would reply, since they equally covered the salient features to which he desired to refer. These inquiries covered the following points:—"Why has it been necessary to do so large a business to secure so small a showing of profit?" "Are the company's sale prices too low, and if so, what does the company propose to do toward increasing them?" "What is the effect of competition?" "What about the value of the company's share assets?" "To what degree is the company's management economical and efficient?" "What programme has your board for the future?" and "What as to the future business the company may anticipate?" It no doubt appeared singular to them, at first glance, that such a plant as they had at Trafford Park, and so complete an organisation, had not been able to show a greater profit during the year. It was self-evident that the works were not built for the moment, but for a volume of business which was to be counted upon either at once or in the near future. Having been constructed with that end in view, and the expected development then anticipated not having yet taken place, an abnormal expenditure, both in the original outlay for their plant and in its completion and operation, had naturally resulted. In the accounts considerable sums were connected with what might properly be called the completion of the plant, since there was included within the item of £34,929 charged for buildings, the completion of the railway trackage within the grounds, to enable engines and wagons from the outside to pass over their trackage with safety, so that the works might economise in incoming and outgoing freight; there was further included the cost of a steel railway bridge required for the same reason—that for the completion of the roads about the works; that for a roof connecting the iron foundry with an adjacent building, which, at the time it was undertaken, more than a year ago, was deemed by the management a wise precaution to take in order that ample covered space might be had for the large castings it was proposed to make. There was further included a large gas-producing plant, with the attendant extensive piping mains throughout the grounds. This was required not only that they might have a sufficient supply of gas to enable the works to do away with the necessity of purchasing the large quantity of gas bought from the city for various purposes throughout the shops, but also to take the place of other fuel in a portion of the furnaces, and, in addition, to supply the large quantity required to test the gas engines built at the works. Even with this addition to the generating plant, the works are still obliged to buy a considerable quantity of electrical power from outside, and it was believed that within the next year it might be an appreciable economy in the end to add to the plant gas engine units that would render the works self-contained and do away with the necessity of purchasing any power from the outside. In the item of £178,402 for machines, tools and equipments, a number of tools and machines ordered previous to the beginning of the fiscal year under review were included. These two sums had seemingly, practically completed the installation of the works. The apparently too extensive character of the plant at the outset, if they judged only by the present, naturally gave rise to a works organisation on similar lines, and to an extensive selling organisation, because of the endeavours that had to be put forth to see that no opportunity should be allowed to pass, that would tend to furnish as much work as could be secured for their plant. At that time it was believed that important electrical developments in Great Britain—especially in methods of transportation and in electrical distribution—were within sight. While this belief had not yet been fully borne out by results, he did not think any person conversant with the trend of affairs to-day would deny that a radical change in the present methods of transportation in this country—within certain wide limits, at least—was to-day a self-evident certainty; but, as to whether this would take place within the next year, or within the next two, or three, or five years, he was not willing to hazard an opinion. Starting, as these works did, a year and a half ago, the plant had been, for the moment at least, undeniably able to take care of a very much larger amount of work than had been found for it and it had thus been expensive in every way, while the organisation brought together at the same time upon the same basis could not help but entail more than usual expense. It was equally to be borne in mind that during a considerable portion of the year under review a large number of men were still engaged upon what could be properly called "unproductive labour," namely, the completion and finishing up of their works and grounds in the directions he had indicated heretofore. The character of some of the chief work undertaken by the company more than a year ago had also been a factor in the results attained; he referred particularly to the great turbines now being completed, the first of which were just beginning in London to do their work of furnishing power for the underground railways. This work was so entirely new in every way, and involved such great risks in construction and operation, that every precaution that prudence could suggest was demanded of their staff at the works. The development charges thus brought about were of necessity large, covering as they had to do, all the unforeseen expenses incident to such intricate, large engineering and manufacturing problems. This work entailed a designing and engineering force out of proportion to what would be required in any ordinary manufacturing plant, wherein a well-established product was simply being turned out. As the same things were now called for, or like things of different capacities, their production in the works would become but a matter of manufacturing, instead of one of origin, development and manufacturing, as in the case to which he had referred. He was asked whether their sales prices were not too low, and, if so

what effect competition had upon them, and what steps it was proposed to take to secure better prices for the product of their works. This was in reality the kernel of their business, and the most important matter that could engage the attention of a manufacturing company, since every economy that could be made in expenses could be quickly swallowed up by a drop in the prices received for a company's product. The price at which any commodity could be sold was, with the exception of things closely protected by patents, a matter of the market quotation therefor, and the depressed condition of general business in Great Britain during the past year or more had not, therefore, assisted manufacturers in securing the prices they should for their product, since large manufacturing works like theirs, with heavy fixed operating charges, must be furnished with something to do, and it hence became most difficult at times when the demand for a product was very limited for the management of such a company to do anything to bring about fair prices for its products, since they knew that their competitors were, for identically the same reasons, equally anxious to secure whatever work might be found. This condition, which applied to the British electrical manufacturing trade with more force than to any other, was measurably responsible for electrical material being sold here at lower prices than should be the case. But there was another competitive element, far-reaching in its results, that had entered into this matter of the prices the company had been obliged to meet—he referred to a phase of business that was part of the public policy of this country, and hence a thing concerning which no preventative steps could be taken by a British manufacturing concern—namely, the competition met with here from manufacturing concerns outside Great Britain. His own view of this phase of competition, and of its results, was, that it was not so much the amount of business contracted in Great Britain by German and other Continental electrical manufacturing concerns—very large as that was—but, rather, the influence the presence of this competition in all important tenders exerted upon prices quoted by British manufacturers since the logical sequence to be drawn from such a condition was that it became necessary for the sales department of a British company to try in advance to discount this unknown outside price, with the net result that much lower prices were made by British companies under such circumstances than would be the case were the competition they had to meet limited to Great Britain alone. It was difficult to see how British manufacturing concerns could adjust their business to meet this wider competition, and at the same time satisfactorily uphold even fairly remunerative prices for their products, since they were not able even to take any reprisals because of the equal fact that the public policy of their competitors' countries protected the latter from such attack. This feature of competitive business at home being embodied in British public policy, was hence beyond the control of any board. His individual belief was that it was a matter of more importance to manufacturing interest here, and especially to such as their own, than appeared to him to be realised by many. To those who directed large specialised manufacturing companies like their own, that had to meet this wide competition to a greater extent than did others, there was but one course left open, viz., to courageously use their very best endeavours to meet the situation by economical work, and then to go ahead and secure as large a proportion as possible of work offered at the best obtainable price. If they would now recall what he first said as to why the cost of the material heretofore made by their works had been high, they would, from what he had just said, see how with low prices small profits had resulted to their company. With regard to the company's investments in other companies, might he say that the Traction and Power Securities Co., the shares of which their company held to the amount of £250,000 (£175,000 of which have been paid up), was a finance company formed three years ago, one of the objects of which was to create a financial company that would join their company in connection with the financing of business undertakings, the carrying out of which would furnish work for their factory. It frequently happened, as all of them knew, that such undertakings as power or lighting companies, or the electrical transformation of transportation lines, found it convenient and desirable where the contracts were large, to pay for equipment and material to some considerable extent, in their own securities instead of in cash. The Traction and Power Co. had been the medium through which in several instances such securities had been handled in connection with work of their company, they taking them in cases where they had been offered to them on mutually advantageous terms. Several large cash contracts, for which they would otherwise have had to accept payment in securities, or, allow the business to go to other concerns ready to undertake upon like conditions, thus resulted for this company. For the first 17 months of the existence of the Traction and Power Securities Co., it paid a dividend at the rate of 6 per cent. for the period, equal to about 4¼ per cent. per annum. For the next 12 months ending December 31st, 1903, it thought it advisable not to declare a dividend, but carried forward its earned profits—£12,371—including the sum brought forward. With regard to the shares held by the British Westinghouse Co. in the Clyde Valley Electrical Power Co., this company, which he thought was the largest power development company that had been thus far undertaken in Great Britain, covered as territory the thickly populated manufacturing districts adjacent to Glasgow, without doubt one of the very best fields for such a company in Great Britain. The entire equipment for the company's two large power stations had been built at the Trafford Park works, and was now being put in place. Close investigation led all who had considered the subject to the conclusion that there was every evidence to warrant a confident belief that the Clyde Valley Co. would be a most profitable one, almost from the moment it was able to furnish ample power to the district in which it was located; and from the knowledge had of the satisfactory experience of power companies already in existence in England, within less favourable territory, one could but feel confident that the completion of the works of the Clyde Valley Co., and their operation—which would be within next year—would amply justify the action of the board in taking hold of this large undertaking, and that the shares this company held in it would then find a profitable market. It was to the building of such large electrical undertakings as these that electrical manufacturing concerns, such as their own, must in a considerable measure depend for their success; and it might not be out of place to say here that an indication of the extent of interest now being shown in Great Britain in electrical power distribution companies might be had from the considerable number of Bills covering such measures that he was told would come before the next session of Parliament. The Adelaide Development Co., in which they held some shares, was a company formed several years ago for the purpose of taking steps to secure a charter for the electrification of the tramways of Adelaide, Australia. Shares in this company were equally held by several other manufacturing concerns whose business was co-related with that of their company. Within the past two weeks notice had reached them that the Australian Government itself proposed to take up the work in question, so that steps had been taken to enable the company to recoup itself for its investment in the Development Co. Almost all the other securities held by the company were in electrical power development companies in England, wherein securities were taken for a portion of the contract price. These shares had a market value, which, in one or two instances he was glad to say, was to-day even greater than was believed probable when the companies were organised, or during their earlier operation just now beginning. This was a good indication as to the intrinsic merit that existed in electrical power distribution companies, and was most encouraging for their interests. He was asked to say something with regard to the condition of the company's property at Trafford Park in view of the auditor's reference to the matter of depreciation thereon. Concerning their buildings and grounds, in the accounts under review a considerable sum had gone into their completion, but, quite aside from this, special care had been exercised and thought given to the conservation and upkeep of their buildings, and he personally believed they were to-day as valuable, in point of fact, as they were a year ago. They were built of steel, brick and slate, and the short time that had elapsed since their construction, plus the care that had been taken of them, to his mind justified the judgement of the board that no depreciation was necessary in making up last year's accounts. With regard to their large machine tools and general plant equipment, it was equally true that these had been maintained at a very high degree of efficiency. During the year the very considerable amount of £25,490 had been charged to general expenses in connection with their maintenance and with improvements made upon them, which had tended to greatly increase their efficiency in many directions, and thus reduce the cost of the product they turned out. This, taken in connection with the fact he had stated, that many new tools were added during the year to complete the installation, coupled with the proportionately limited amount of work put through the factory—compared to its capacity—which relieved some of the larger tools from much service during the year, appeared to the board to warrant their view that the amount of £10,500 charged off for depreciation thereon was, under these circumstances, a fair adjustment. In the matter of patterns and dies and small tools, he might say that quite outside the sum of £19,033 charged against their upkeep and maintenance during the year, the board, at the middle of the fiscal year under review, adopted the policy of charging all dies, patterns, small tools, drawings and blue prints, direct to factory expenses, or to a particular contract. The sum charged to factory expenses alone for these things during the six months to which he referred, amounted to £20,346. He thought they would agree that in this the policy of the board had been wise, and that this latter large expenditure amply warranted the board in its belief that no depreciation was, therefore, required upon the items thus covered. Beyond these explanations it was, of course, clear to all that the general subject of depreciation would more properly come up for consideration when the profits warranted a dividend being paid. Realising that the moment was not in sight when the capacity of their works, and of the organisation that had been perfected in connection with them, could be advantageously used, the board with the hearty encouragement of all the officers of the company, immediately set about reducing general expenses and the cost of manufacturing. Much had been accomplished in that direction. Indeed, it was gratifying to feel that the cost price at which work was now being produced in the factory was steadily dropping in all cases, and that it was nearing a normal mark in several. This was because their workmen were now becoming efficient units in a whole, and the organisation more coherent and better co-ordinated for the work in hand, through the decrease in its *personnel* that had been found possible. It was a pleasure to say that the efficiency of the workmen of all kinds engaged at Trafford Park was now of an excellent order, and that their output would compare favourably with that turned out by any similar works anywhere. Much of the ultimate benefit that should come from all this could be, however, rendered valueless should prices continue to fall, or other unforeseen things occur to the disadvantage of, or that occasion serious loss to, this company. With regard to the management of the company and the programme the board had for the future, and its hopes as to the outlook for business, much that he had said bore directly on that point. The board realised—possibly more deeply than some of them might think—the difficulties they had to contend with, and those still before them, and their obligation to the proprietors of the company to do everything that lay within their power towards bringing about the results hoped for by all, and confidently believed in by the principal proprietors of the

company. It was a pleasure for him, practically a stranger among them, to bear cordial approval to the earnest work that had been done in these things by all concerned in the management, and to their anxiety, their interest, and their efforts towards doing all they could to bring success to the undertaking in their hands. As to what the future might bring in the way of business, he could not say, nor would he hazard an opinion, no matter how firm might be his individual convictions with regard thereto. It seemed fair to assume, however, that if the development in electrical traction in Great Britain, to any measureable degree, kept pace with the outlook now existing in the same direction in the United States, there should be, with the gains that seemed likely to take place in the demand for electrical apparatus in the British Colonies, sufficient work in the near future for the electrical manufacturing concerns in Great Britain. Their plant and organisation at Trafford Park were equipped to this end, while the experience of their workmen had brought about a lower cost for their finished products, so that they were to-day much better fitted to profitably tender for and produce electrical equipment than they had been at any time heretofore; and he was glad to say that, from his observation, the whole tendency of things in the works at Trafford Park lay in the direction of still better and more satisfactory conditions in these regards. The improvements he had mentioned were certainly encouraging signs in connection with their undertaking, and they also indicated the difficult road along which it had had to pass up to this time. Their co-proprietors on the other side of the water felt the strongest possible interest in the company, and a certain confidence in its ultimate success. They had spared, and were sparing, no efforts that would assist towards bringing about this result, and the best evidence concerning the confidence felt by them for the future that he could adduce appeared to be expressed in their action during the past year, in which, without asking one penny from British shareholders, their American associates had invested 900,000 more sovereigns in the business. Men who backed their judgement and belief with their money in so striking a manner were unquestionably entitled to the confidence and encouragement of others who were interested with them.

Mr. J. H. Lukach seconded the adoption of the report for the year ended July 31st, 1904.

Mr. H. W. Birks expressed extreme disappointment with the report, and said that they had been buoyed up by statements made at former meetings. After quoting from these statements, he said that if they had known that they were to build the works for posterity, they would probably never have been built at all. But they might be willing to let bygones be bygones, if the chairman would only give them some assurance as to the return they would get this year.

Mr. Kitchin asked the chairman to either confirm or dispose of altogether the statements which had appeared in the financial papers that Messrs. Dick, Kerr & Co., Ltd., proposed to absorb this company. Such remarks had been made more than once, and shareholders would like to have their minds set at rest. Not that there was anything to say against such a firm as Dick, Kerr & Co., which seemed to be one of the few businesses in this country which was properly managed.

Mr. Brown said that a few years ago the newspaper Press was continually saying that this country was played out, and it was said that when Mr. Westinghouse came over from America, all this would be altered! The company now had a very big house full of costly toys that took a great number of men to keep in good order. It was like building a palace and furnishing it before they had got anybody to dwell therein. He said that the thing had been most extravagantly worked and conducted, and that what they wanted was a little more common sense and economical management. They ought to have an inspection committee to look into the affairs of the company.

Another shareholder supported the suggestion for a committee, but the idea was strongly objected to by others, who argued that no one but most exceptional experts would be capable of analysing the financial and technical details of such a huge and difficult business. Another suggestion made was to the effect that a fuller profit and loss account should be given; shareholders wanted to know the gross earnings on their capital, they would then know the amount of business that they were doing. One more question was asked, as to the rate of interest on the temporary loans.

The Chairman replied to the remarks somewhat as follows:—First of all, from his limited experience—he was not, fortunately, as old as he hoped he would be—he had never met a body of men connected with an undertaking who had to his mind more anxiety, nor who had worked harder to bring about a different result than those who were in the company's employ. Every man as far as his knowledge went, on the pay-rolls of the company in any way, was earning what he was receiving, with one exception—and modesty precluded him from indicating who that was. It was not a light matter—nevertheless it might appear entirely different to some of them—to organise, equip, and operate a great manufacturing concern, involving within its operation practically everything that went into modern engineering. As to whether there should be such concerns he had nothing to do; he was trying to deal, as a stranger who came among them, with an existent fact. He was trying to approach that fact in a fair and equitable light as he himself saw it, and he was trying to look at it from his standpoint, because in addition to his own individual responsibility, he was representing their associates who had a very large sum of money invested in the undertaking which was represented by their holding. Those men did not go into the thing in an unthinking moment. It was but fair to assume that every man who put his money into an undertaking did so in the belief that it was a good thing—the facts might be that his judgement was entirely wrong, but he was entitled to the belief and to the conviction. In regard to the question of what the future might be—it was all involved in that, what hope could be held out?—his observation in life had given him grave doubts as to the value of prophecy with regard to business undertakings. They grappled with questions that presented themselves with the best intelligence they could, and put them into the hands of men most competent to take care of them, and the results must be what all those forces produced. He wanted to assure them that if he saw any serious things on the dark side he would certainly not hesitate to indicate them to the shareholders. He did not want to talk to them of what he might see on the bright side, because the criticism was made that there had been too much of that already. He hoped they would not expect him to step exactly into a path for treading into which they had just criticised others. He wanted to do what he could toward bringing down the expenses of the concern, because that, after all, was the kernel of it. He wanted to do what he could towards building up prices. Those two things would make a profit, but if those two things failed, they would lose. He was not gifted with insight into the doings of other people. Business houses kept their secrets to themselves, and he was not able to say whether Dick, Kerr & Co. were buying the stock of this concern or not. His knowledge might be hopelessly imperfect, but, so far as he knew, there was no basis for the report whatever; but his knowledge might be quite wrong. The average rate of interest paid to bankers had been 4½ per cent. The sundry creditors of the company on July 31st were £374,687, and there were temporary loans to the extent of £200,750. The sundry creditors on October 31st, 1904, were £248,562, and the temporary loans were *nil*. The cash at bankers on December 6th, 1904, was £90,000, and the unpaid vouchers in the offices were £45,776. The goods in process of manufacture at October 31st amounted to £334,397. They had in finished product on that day a very much larger amount than they required, or than they should have (it was £251,846). Every effort must be made towards reducing that. This had resulted because of the fact that, in respect of some of the very large contracts undertaken a year or two ago by the company, a great deal of material had been unable to be taken yet by the concerns that ordered it, because their power stations were not ready to receive it. That was on hand, but it was too large for such a company as this. This was equally true of the stock of raw materials, a great deal of which was copper bought when the price seemed certain to rise, and it had risen. If the company had a business commensurate with what they should do to make good dividends, it might still require that they should find more capital for working expenses. If any man could tell him how it was possible to do two, three, or four millions of pounds' worth of business upon £500,000, he would be glad to have the information. In regard to general expenses, he might mention that the entire engineering force of the company would move on May 1st next from London to Trafford Park.

The motion for the adoption of the report was carried unanimously.

The retiring director and auditors having been re-elected, a vote of thanks to the chairman, directors and staff, brought the meeting to a close.

Aron Electricity Meter, Ltd.

The meeting of this company was held on Thursday last week at Winchester House, Mr. H. Hirst presiding.

The Chairman, in proposing the adoption of the report, said that although he was by no means proud of it, yet it recorded a progress in the right direction, and indications were not wanting that a more prosperous era was in front of the company. The profit and loss account showed a gross profit on trading of £23,256 7s. That might just as well be called net profit on trading, as all the expenses connected with the manufacture and sale of meters were deducted before that amount was arrived at. The amount written off for depreciation, £4,725, was considered ample by the auditors. Directors' fees and managing director's salary were still on the reduced amount. Maintenance of patents was this year apparently higher, yet the actual amount expended was higher still. The £1,840 standing in the accounts only represented out-of-pocket expenses, but not the actual time and brain work of the staff and management, nor rent, power, &c. It was of the utmost importance to the company that every advance in the meter business should be watched, and that every experience gained by them and others should be taken note of, and every improvement taken advantage of, in order to keep up to date and periodically produce new things, which opened up a new lease of life for the company. After deducting all charges and expenses there resulted a balance of £10,679, which was the real amount of the net profit with which they had to deal. They had to use £4,645 to wipe out the trading loss carried forward from 1901-2, and, in accordance with the trust deed, they had to set aside £2,500 for the debenture sinking fund. With the balance they proposed a dividend of 2½ per cent. on account of the preference dividend in arrear, leaving £412 to be carried forward. Assuming the coming year to be no better than the past, they would not have to deal with an adverse old balance before the interests of the shareholders could be considered; it would then be time to fix a desirable amount to be carried forward from year to year. As regarded the balance-sheet on the debit side of the account, the figures were very much the same as before, with the exception that the amount of debentures outstanding had been reduced and the sinking fund was increased by the amount of the yearly quota. On the credit side the first item, goodwill, patents, stock and shares in American company, &c., was increased by about £2,000. That was entirely accounted for by the additional buildings erected during last year, which also had to be filled with machinery and tools, all

of which expenditure was sanctioned at the last annual meeting. Stock of meters and parts was increased by about £6,100. Sundry debtors and outstandings were really exactly the same as last year, with the exception of £3,000, which was owed to them by the American company and had since been paid. Last year he stated that an effort was being made to bring new life into the American business. As a matter of fact, their American friends met with a number of difficulties which were accentuated by the fact that this company was not doing any too well during the last two years, of which fact their competitors made the greatest possible use. They were on the point of giving up their efforts when they thought it wise to make a certain sacrifice which would enable them to find room for useful new interests within their organisation. There were also certain points in their agreement which were open to various interpretations, and by making the arrangement noted in the balance-sheet, they thought they had carried a very difficult business through successfully. As regarded the outlook, he could only say that the words of the report exactly explained the position. The business they had done since October 1st justified them in anticipating a continuance of sound trading during the coming financial year, unless circumstances beyond their control arose affecting the electrical industry generally. Personally, he was particularly hopeful that the new alternating current motor meter would catch on in this country, and as the factory was now built and ready to supply, they would not be long before they were in a position to know whether his hopes would be realised. In the meanwhile, the existing clockwork meters were being bought in increased quantities all over the Continent at prices which he thought their balance-sheet had proved was leaving them a reasonable profit. Dr. Aron himself, and his staff, continued to give the most assiduous attention to all the details of the business, and their hard work and optimism throughout the last year had been one of the most encouraging features in the business.

Mr. Roger Wallace, K.C., in seconding the motion, said that the company had certainly gone through lean years, but he was hopeful that it was now about to enter upon an era of prosperity.

The report was adopted.

Isle of Thanet Electric Tramways and Lighting Co.

The report for the year ended September 30th last, to be submitted to the meeting on 14th inst., shows a balance at credit of profit and loss account of £13,493. Traffic receipts amounted to £35,005, as against £33,465 last year, and the sale of electricity to £2,291, against £904; the total receipts for the year being £37,620, an increase of £2,943. To pay debenture interest, dividend on preference shares, interest on loan, fees to debenture trustees, and income-tax, an additional sum of £2,454 was required, which had been taken from the unappropriated balance at the credit of last year's revenue account. Owing to objections raised by the Board of Trade to the double truck cars, it became necessary to alter them, and to mount them on single trucks at a cost of £1,833, and the balance of the special account for "improvement and reconstruction of cars (£1,800)" would be written off revenue in six annual instalments. Owing to pressure of other engagements, Mr. Arthur Wright resigned his seat at the board, and it is not proposed to fill the vacancy.

R. Hornsby & Sons.

At this company's meeting on Monday, Mr. H. Simpson Gee (the chairman) said that at their last meeting he stated that the outlook for the trading of the coming year was not very rosy; and after the experience of the past year, he regretted to say that trade generally had been bad throughout the country. With respect to the home trade, they had kept up their returns, but it had been at the expense of the profits. Business being bad, it had been more difficult to get, and greater expense had been incurred in seeking orders. They had also kept larger stocks of finished goods in order to effect quick delivery. In South Africa, where it had been hoped that trade would be good after the effects of the war had passed away, business had been worse in the past year than it was in 1903, and the company had done considerably less business there. They hoped some day, however, that they would do a good business in South Africa. He had, on former occasions, stated that the company's works were being remodelled; they were building new workshops and putting in up-to-date machinery. During the past six or seven years very large sums had thus been spent. They were endeavouring to do all this work without increasing the capital account. Whether they would succeed in this effort depended very much on the state of trade. At the present moment the company's works were fully employed. They had more orders in hand that day than they had on the corresponding day last year, and, so far as turnover was concerned, the prospect for the coming year looked very satisfactory. They had done much more business since September 30th than they did in the corresponding period last year. So far, however, as the question of profit was concerned, they must wait to see the result. The competition they had to meet was very keen, as was always the case when trade was not very good.

Stock Exchange Notice.—The Committee has appointed a special settling day as under:—Wednesday, December 14th, Telephone Company of Egypt, Ltd.—60,000 4½ per cent. debenture stock, and has ordered same to be quoted officially.

Electric and General Investment Co., Ltd.—The directors have declared the following interim dividends:—At the rate of 6 per cent. per annum on the preference shares for the six months ending 31st inst., and at the rate of 10 per cent. per annum on the capital paid up on the ordinary shares.

STOCKS AND SHARES.

Wednesday Evening.

To have commenced the second week in December without a rise in the Bank Rate is unusual enough for the negative event to deserve comment. The markets are now so well prepared for an advance that its coming or tarrying is immaterial. But politics are again a factor of unsettlement, and while nobody professes to look for alarming incidents, the atmosphere is charged with a vague uncertainty which tends to restrain business. Telegraph securities are still the hardest amongst electrical departments, and the changes in that section show a goodly proportion of rises.

Metropolitan Railway Consolidated fell sharply to 98 upon well-founded rumours that more money would soon be required in connection with the electrification, despite the issue of Convertible Preference that has only just been made. The price of the latter is about 2½ premium. It is thought that the next lot of stock will take the shape of more Debentures. The present 3½ per cent. Debenture stock stands at 105, a point above the quotation of the 'A" Debenture. District 4 per cent. Debenture stock is 104½, and the 6 per cent. 155, but it is not easy to buy any substantial amount of either. Underground 5 per cent. Profit-sharing notes are now 97 *ex* 2½ per cent. interest. East London Ordinary remains at 5⅜, and District Ordinary at 41½, having recovered from 41. The capital requirements of the Metropolitan Railway naturally arouse a wonder as to whether the District Railway may not have to look round for more money when the New Year has turned. Central London, City and South, and Waterloo and City stocks have no alteration to show this week.

In the Traction and its associated markets, British Westinghouse Preference have provided a good deal of interest, and a rumour went abroad to the effect that the English branch of the company was to be brought into close relations with Dick, Kerr & Co., through the acquisition by the latter of a controlling interest in British Westinghouse shares. At Tuesday's Westinghouse meeting, the chairman said that, so far as he knew, there was no foundation for the rumour, but this guarded utterance only serves to whet curiosity. The Dick, Kerr undertaking has an authorised share capital of £650,000 in £5 shares, which are now fully paid, and of this amount £85,000 remains unissued. There is also £300,000 in 4½ per cent. Debenture stock. The Ordinary shares stand at 7½, and the Preference at 5⅜. Westinghouse Preference have recovered to 3, although the chairman admitted that the company would probably have to raise more working capital.

After being dull, Anglo-Argentine Tramway shares have improved, the Ordinary to 7⅜, and the Preference to 5 9/16, it being stated that the strike is wearing itself out. City of Buenos Ayres at 10⅜ are also a trifle firmer. British Electric Traction Preference at 10⅞ show a loss of their last week's rise, and London United Tramways Preference eased ¼ to 10¾, upon the new railway projects to which we have already alluded. The Debenture stock is 104. Barcelona Trams are a good market at 10 11/16, and a fair amount of business in Buenos Ayres and Belgrano Tramway Ordinary leaves the price at 3 13/16. Cape Electrics at 30s. are 1/16 lower.

Telegraph varieties are more strong than active. There is so little stock about that a very slight demand suffices to raise prices, and the stream of investment having turned in favour of several Telegraph descriptions, there is another general improvement. A few prices relapsed. Anglo-American Deferred has gone back ⅞ to 11⅜, and Direct United States at 10⅞ are ¼ down. Otherwise, the list presents a very healthy appearance, West India and Panama issues being especially sought after. Great Northerns added a further 15s. to their last week's advance of 5s., and Direct Spanish Ordinary moved up ¼ to 2⅜. These are the principal movements, in which Globe Telegraph Ordinary sympathised to the extent of ⅛, making the price 10¼. China shares rose ⅛, and Eastern Ordinary stock a point to 13⅝ and 134½ respectively. Some of the Telephone shares are also better. Chilis, for instance, put on ⅛ at 5⅞, and United River Plates a similar sum at 6⅞. Monte Video Telephone shares hardened 1/32, and National Telephone Preferred is 1 per cent. better at 108½. But British Insulated and Helsby Cables Ordinary and Preference are both ¼ lower, standing now at 5¼. India-Rubber shares drooped to 19½, a 10s. fall, while Henley's Debenture is a point better.

Continued expansion is the reason why the Bournemouth and Poole Electric asks its proprietors to subscribe for 3,000 new Ordinary at £11. As the existing Ordinary are 12½, it is not likely that the offer will be refused. Edmundson's Ordinary and Preference have again risen ½, it being announced that the new issue was well subscribed. Charing Cross Ordinary shaded off to 8½, and the two later Preferences are each ¼ lower at 4⅜. A rise of 10s. in Kensingtons put up the price to 13, and Metropolitan Preference rose 1/16 to 5½; there is a good deal doing in them. St. James's have declined ¼ to 14½, and South Londons ¼ to 4½, but the Urban issues are good. In the provincial list, Oxfords are harder at 6½. Amongst Miscellaneous issues, British Aluminium Preference have risen no less than £1 upon the better prospects for the company, and Crompton Debentures are again a point higher.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1901.	1902.	1903.	Closing Quotations Nov. 30th.	Closing Quotations Dec. 7th.	Business done week ended Dec. 7th, 1904. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	99 —102	100 —103	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	1 — 1½	1 — 1½	..	..
112,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	.. — ..	.. — ..	..	..
788,840	Anglo-American Telegraph	Stock	61s.	60/6	61s.	56 — 58	56 — 58	56	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	102 — 104	102 — 104	103	102
3,105,580	Do. do. do. Deferred	Stock	2s.	1/-	2s.	12⅜— 12⅝	11⅛— 11⅜	$12\frac{9}{16}$	$11\frac{7}{16}$
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	6 %	7 %	5⅜— 5⅝	5⅜— 6	..	..
13,888,800$	Commercial Cable	$100	8 %	8 %	..	170 —190	170 —190	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	92 — 95	92 — 95	94½	93½
16,800	Cuba Telegraph	10	4 %	6½%	5 %	8⅜— 9⅛	8⅜— 9⅛	9	8⅜
6,000	Do. 10 % Pref.	10	..	..	..	16⅛ — 17½	16⅛ — 17½	..	..
12,981	Direct Spanish Telegraph, Ord.	5	..	..	..	2⅛— 2⅜	2⅛— 3⅛	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7⅛ — 8	7⅛ — 8	7⅞	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	100 —102	101 —103	..	..
60,710£	Direct United States Cable	20	3½%	3½%	3 %	10⅜— 11⅛	10⅜— 11	11	10⅞
81,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	100 —102	101 —103	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	132 —135	133 —136	134½	132½
1,955,565	Do. 8½ % Pref. Stock	100	..	..	..	88 — 90	88 — 90	89½	88½
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —107	105 —107	106⅛	105½
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	13½— 13¾	13⅛— 13⅜	13⅜	13¼
800,000£	Do. 4 % Deb. Stock	Stock	..	..	..	106 —108	106 —108	..	..
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	101 —103	101 —103	..	..
800,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	100 —102	100 —102	..	..
180,227	Globe Telegraph and Trust	10	5½%	£3 16 7*	5½%	9⅞— 10⅛	9⅞— 10	10⅛	9⅞
180,042	Do. do. 6 % Pref.	10	..	..	..	13¼— 14	13⅜— 14	13¾	..
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	12½%	15 %	28½— 28¾	29 — 29½	28⅞	..
54,700	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	100—102	101 —103	..	..
17,000	Indo-European Telegraph	25	10 %	10%	10 %	44½— 46½	44½— 46½	46	44
72,680	Monte Video Telephone Co., Ltd., Ord.	1	2½%	3 %	3 %	$\frac{29}{32}$— $\frac{15}{16}$	$\frac{29}{32}$— $\frac{29}{32}$	$\frac{29}{32}$	..
1,988,333	National Telephone, Pref. Stock	100	5 %	6 %	6 %	107 —108	108 —109	108½	107½
1,966,667	Do. do. Def. Stock	100	..	44%	5 %	96½— 97½	96½— 97½	97½	96½
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	13⅛	13¼
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 13	12 — 13	..	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5½— 5⅝	5½— 5⅝	5½	..
000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	98 — 99	98 — 99	98⅝	98
689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	104½—105½	104½—105½	103½	104⅜
1,000,000	Do. do. Prov. Certs., 35 % to be paid	..	..	..	..	67½— 68½	67½— 68½	68⅜	67½
179,318	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6½%	⅞— 1 1/16	⅞— 1 1/16	..	..
50,000	Do. do. 6 % Cum. Pref.	1	..	..	..	1⅛— 1¼	1⅛— 1¼	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	98 —100	98 —100	..	..
11,889	Reuter's	8	5 %	5 %	..	6⅜— 7⅛	6⅜— 7⅛	..	..
3,808	Submarine Cables Trust	Cert.	..	..	..	119 —122	119 —122	..	..
58,000	United River Plate Telephone	5	7 %	7 %	..	6⅜— 6⅝	6⅛— 6⅜	6 1/16	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	5⅛— 5⅜	5⅛— 5⅜	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	105 —107	105 —107	106½	106
15,609	West African Telegraph, Shares	10	..	2 %	4 %	7½— 7¾ xd	7½— 7¾xd	..	..
30,008	West Coast of America, 1 to 30,000 and 53,001 to 53,009	2½	..	..	..	1/16— 1/16	1/16— 1/16	1/16	1/16
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	..	..	..	98 —100	98 —100	..	..
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	7 %	13⅜— 13⅝	13⅜— 13⅝	13⅝	13 1/16
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	102 —104	103 —105	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	101¼—103½	101¼—103½	103	..
86,221	West India and Panama Telegraph	10	..	..	..	⅝— ¾	⅝— ¾	..	..
24,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	7⅛— 7⅜	7⅛— 8	8	7 1/16
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	6⅜— 6¾	6⅜— 7⅛	..	..
90,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	103 —105	103½—105½	104¼	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	5⅜— 6⅛	7 — 7⅛	..	..
10,000	Do. do. "A" 6 % Cum. Pref.	10	..	..	..	8⅛— 9⅛	8⅛— 9⅛	..	..
800,000£	Do. do. 5% 1st Mort. Deb. Stock Red.	Stock	..	..	..	96 — 100	96 — 100	..	..
100,000	British Electric Traction	10	9 %	8 %	..	9⅜— 10⅛	9⅜— 10⅛	9 1/16	9⅞
100,000	Do. do 6 % Cum. Pref.	10	..	..	..	10⅞— 11⅛	10⅞— 11	11	10 13/16
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	117 —119	117 —119	119	118
	Do. do. 4½% 2nd Deb. Stock Red.	100	..	..	..	95 — 97	95 — 97	96½	..
100,000	British Insulated and Helsby Cables	5	10 %	10 %	8 %	5⅛— 6	5⅛— 5⅜	5⅛	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5⅞— 6	6 1/16— 6⅛	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	102 —105	102 —105	..	..
50,000	¶Brownett, Lindley & Co., Ord.	£1	Nil	..	..	1/16— 1/8	1/16— 1/8	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	..	..	14/6 to 15/6	14/6 to 15/6	..	..
105,781	Brush Electrical Engineering, Ord., 1 to 105,781	2	Nil	Nil	Nil	⅝— ¾	⅝— ¾	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	3 %	6 %	6 %	1⅛— 1⅜	1 — 1⅛	1 1/16	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	93 — 96	93 — 96	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	69 — 73	69 — 73	..	..
85,000	Callender's Cable Construction shares	5	20 %	15 %	12½%	9⅛— 10	9⅛— 10	..	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5⅛— 5⅜	5⅛— 5⅜	5 1/16	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Red.	Stock	..	..	..	104 —106	104 —106	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	93 — 95	91 — 93	92½	..
494,998	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	101 —103	101 —103	101	..
494,998	Do. do. Def. do.	Stock	4 %	4 %	4 %	84½— 86	84 — 86	..	..
1,330,000	City and South London Railway	Stock	2 %	3½%	2½%	45 — 47	46 — 47	47	46⅞
85,000	Crompton & Co., Nos. 1 to 85,000	8	7½%	5 %	..	1½— 1⅝	1½— 1⅝	1 1/16	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	92 — 97	90 — 95	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £8 paid, 1 to 99,261	5	Nil	Nil	..	⅜— ⅞	⅜— ⅞	..	..
17,189	Do. do. "A" shares, 01—017,189	5	Nil	Nil	..	1 — 1½	1 — 1⅛	..	..
814,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	78 — 83	78 — 83	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	79 — 84	79 — 84	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	6 %	4 %	1⅜— 1½	1⅜— 1½	..	..
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	..	..	..	2⅛— 2⅜	2⅛— 2⅜	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	98 —100	98 —100	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9½— 10	9½— 10	..	..
900,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	91 — 96	91 — 96	..	..
200,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	15 %	10½— 11	10⅜— 11	..	..
200,000	Do. do. 4½ % Pref.	5	..	..	..	5⅞— 5⅞	5⅞— 5⅞	5⅞	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	109 —111	110 —112	112	..
60,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	19¾— 20¼	19 — 19½	19 3/16	19¼
800,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	99 —102	99 —102	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	1½%	..	3 1/16— 3 1/8	3 1/16— 3 1/8	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10 — 10½	10 — 10½	..	..
37,350	Telegraph Construction and Maintenance	12	20 %	20 %	20 %	38 — 40	38 — 40	39	38 1/16
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	103 —105	103 —105	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3½%	3½%	88 — 90	88 — 90	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List

(Bank rate of discount 3 per cent. (April 21st, 1904).

SHARE LIST OF ELECTRICAL COMPANIES (continued). – ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years 1901.	1902.	1903.	Closing Quotations Nov. 30th.	Closing Quotations Dec. 7th.	Business done week ended Dec. 7th, 1904. Highest.	Lowest
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	†	5	8¾ %	8 % 10 %	10⅜ – 11	10½ – 11	10¾	..
20,000	Do. do. 7 % Cum. Pref. ..		5	.. .. ..		10¼ – 10⅜	10½ – 10⅝	..	..
250,000	Central Electric Supply 4 % Guar. Deb. Stock		100	.. .. ..		104 –107 xd	104 –107 xd	..	..
50,000	Charing Cross and Strand Electricity Supply		5	10 % 10 %	8 %	8⅛ – 9	8½ – 8¾	8⅝	..
70,000	Do. do. do. 4½% Cum. Pref. ..		5	.. .. ..		5⅛ – 5⅜	5⅛ – 5⅜	5¼	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..		5	.. .. ..		4⅜ – 5	4⅜ – 5	5⅛	5 11/16
40,000	Do. do. 1903		5	.. .. ..		4⅜ – 5	4⅜ – 5	4 13/16	..
250,000	Do. do. 4 % Deb. Stock Red.		100	.. .. ..		103 –105	103 –105	104½	104¼
44,486	*Chelsea Electricity Supply, Ord.		5	4 % 4½%	5½%	6⅛ – 6⅜	6⅛ – 6⅜	..	..
150,000£	Do. do. % Deb. Stock Red.	Stock	.. .. ..			109 –111	109 –111	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595 ..		10	5 % 5 %	5 %	10¾ – 11	10¾ – 11	..	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000		10	.. .. ..		13⅛ – 14	13⅛ – 14	..	..
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid		..	.. .. ..		123 –127	123 –127	..	..
300,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid		100	.. .. ..		104 –106	104 –106	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000		10	4 % 4 %	4 %	9¼ – 9⅜	9¼ – 9⅜	9¼	9
20,000	Do. do. do. 6 % Pref., 40,001—60 ..		10	.. .. ..		12 – 12⅛	12 – 12⅛	12⅛	..
400,000£	Do. do. 4½% Deb. Stock		..	.. .. ..		107 –110	107 –110	..	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	.. .. ..		101 –103	101 –103	102	..
70,000	Edmundson's Electric Corporation, Ord. Shares		5	7 % 7 %	7 %	5⅞ – 6⅛	6 – 6⅛	..	..
70,000	Do. do. 6 % Cum. Pref.		..	.. .. ..		5⅞ – 6⅛	6 – 6⅛	6⅛	6
300,000£	Do. do. 4½% 1st Mort. Deb. Stock ..		100	.. .. ..		106 –108	106 –108	107⅛	106
21,000	Kensington and Knightsbridge Electric Ord.		5	10 % 10 %	12%	12 – 13	12½ – 13½	12⅝	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	.. .. ..			102 –104	102 –104	..	..
110,000	London Electric Supply Corporation, Limited, Ord.		3	.. .. ..		2 – 2⅛	2 – 2⅛	..	..
49,840	Do. do. do. 6 % Pref.		5	.. .. ..		5⅝ – 5⅞	5⅝ – 5⅞	..	..
250,000£	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	.. .. ..			97 – 99	97 – 99	98⅛	..
100,000	Metropolitan Electric Supply, 1 to 100,000		10	6½% 7½%	8½%	16⅛ – 16⅜	16⅛ – 16⅜	16⅞	15½
71,108	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..		5	.. .. ..		5⅜ – 5⅝	5 7/16 – 5 9/16	5 9/16	5⅜
290,000£	Do. do. 4½% 1st Mort. Deb. Stock		..	.. .. ..		112 –117	112 –117	..	..
250,000£	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	.. .. ..		97 – 99	97 – 99	..	..
10,862	Notting Hill Electric Lighting		10	6 % 6 %	6 %	14⅛ – 15	14⅛ – 15	..	..
59,000	Do. do. 4% 1st Mort. Deb.		100	.. .. ..		101 –103	101 –103	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.		5	14½% 14½%	14½%	14⅛ – 14⅜	14 – 14⅛	..	..
20,000	Do. do. do. 7 % Pref. 20,001 to 40,000		5	.. .. ..		8⅛ – 9	8¼ – 9	..	..
150,000£	Do. do. do. 3½% Deb. Stock Red ..		100	.. .. ..		99 –101	99 –101	..	..
12,000	Smithfield Markets Electric Supply, Ord.		5	.. 2½% 4 %		2⅞ – 3⅛	2⅞ – 3⅛	3 3/16	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	..	.. .. ..		83 – 87	83 – 87	..	..
65,000	South London Electricity Supply, Ord.		5	.. 1½% 3 %		4⅛ – 4⅜	4⅛ – 4⅜	4 5/16	4 5/32
100,000	South Metropolitan Electric Light and Power (Ord.		1	.. .. ..		⅞ – 1	⅞ – 1	1⅛	..
50,000	(Late Blackheath and Greenwich Dist. E.L.Co.) 7 % Pref.		1	.. .. ..		1 5/8 – 1 7/8	1 5/8 – 1 7/8	..	..
100,000	4½% 1st Deb. Stock		100	.. .. ..		107 –110	107 –110	..	..
80,000	Urban Electric Supply, Ord.		5	.. .. ..		4 15/16 – 5 1/16	4 15/16 – 5 1/16	5 1/16	..
80,000	Do. do. 5 % Cum. Pref		5	.. .. ..		4 15/16 – 5 1/8	5 – 5 1/8	5 1/8	5 1/16
200,000	Do. do. 4½% 1st Mort. Deb. Stock Red ..		100	.. .. ..		103 –105	104 –106	105	104 13/16
110,000	Westminster Electric Supply, Ord.		5	10½% 12 %	13½%	12¾ – 13	12¾ – 13	12 13/16	12¾
28,141	Do. do. 5 % Cum. Pref.		5	.. .. ..		6¾ – 7	6¾ – 7	..	..

* Subject to Founders Shares. † Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, December 7th.

	CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a	Acid, Hydrochloric	per cwt.	5/-	..
a	" Nitric	per cwt.	22/-	..
a	" Oxalic	per cwt.	82/-	..
a	" Sulphuric	per cwt.	5/6	..
a	Ammoniac, Sal	per cwt.	42/-	..
a	Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a	"	per ton	£30	..
a	Bleaching powder	per ton	£5 5	..
a	Bisulphide of Carbon	per ton	£15	..
a	Borax	per ton	£13	..
a	Benzole (90 %)	per gal.	7/-	..
a	" (50/90 %)	per gal.	5/6	..
a	Copper Sulphate	per ton	£23	..
a	Lead, Nitrate	per ton	£25	..
a	" White Sugar	per ton	£31	..
a	" Peroxide	per ton	£27 10	..
a	Methylated Spirit	per gal.	2/6	..
a	Naphtha, Solvent (90% a 160° C).	per gal.	5/6	..
a	Potash, Bichromate, in casks ..	per lb.	8d.	..
a	" Caustic (75/80%).. ..	per ton	£19	..
a	Shellac	per cwt.	240/-	..
a	Sulphate of Magnesia	per ton	£4 10	..
a	Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a	" Recovered	per ton	£5 10	..
a	" Lump	per ton	£5	..
a	Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a	" Crystals	per ton	£3	..
a	" Bichromate, casks.. ..	per lb.	2½d.	..
	METALS, &c.			
b	Aluminium Ingots, in ton lots ..	per ton	£180	..
b	" Wire, in ton lots ..	per ton	£168	..
b	" Sheet, in ton lots ..	per ton	£166	..
b	Babbitt's metal ingots	per ton	£48 to £140	..
c	Brass (rolled metal 2" to 12") basis	per lb.	7¼d.	..
c	" Tube (brazed) ..	per lb.	9¼d.	..
c	" " (solid drawn)..	per lb.	8¾d.	..
c	" Wire, basis..	per lb.	7¾d.	..
c	Copper Tubes (brazed)	per lb.	10d.	..
c	" " (solid drawn) ..	per lb.	10½d.	..
c	Copper Bars (best selected ..	per ton	£81	..

	METALS, &c. (continued).		Latest Price.	Week's Dec. or Inc.
g	Copper Sheet	per ton	£81	..
g	" Rod	per ton	£81	..
e	" (Electrolytic) Bars ..	per ton	£70 10	..
e	" Sheets ..	per ton	£87	..
e	" Rod ..	per ton	£81	..
e	" H.C. Wire	per lb.	9¼d.	..
f	Ebonite Rod	per lb.	8/8	..
f	" Sheet	per lb.	8/-	..
n	German Silver Wire	per lb.	1/6	..
h	Gutta-percha fine	per lb.	8/-	..
h	India-rubber, Para fine	per lb.	5/3½ to 5/7	1½d. inc.
i	Iron, Charcoal Sheets	per ton	£18	..
i	" Pig (Cleveland warrants)	per ton	47/8	..
i	" Forgings, according to size	per ton	From £11	..
i	" Scrap, heavy	per ton	47/6 to 50/-	..
i	" Wire, galvanised No. 8 ..	per ton	£9 15	..
g	Lead, English Ingot	per ton	£13 2 6 to £13 5	2/6 dec.
g	" " Sheet	per ton	£14 10	£2 12 6 inc.
m	Manganin Wire No. 28	per lb.	8/-	..
g	Mercury	per bot.	£7 15	..
d	Mica (in original cases) small ..	per lb.	6d. to 1/	..
d	" " " medium	per lb.	2/6 to 4/-	..
d	" " " large ..	per lb.	4/6 to 8/6	..
p	Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p	" rolled bars & rods	per lb.	1/- to 1/3	..
p	" " strip & sheet	per lb.	From 1/1	..
o	Platinum	per oz.	81/6	..
e	Silicium Bronze Wire	per lb.	10d. to 11½d.	..
i	Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i	" " in bars		£15 to £40	..
g	Tin, Block	per ton	£134 to £135	£3 dec.
g	" Foil	per lb.	1/6	..
n	" Wire, Nos. 1 to 16 ..	per lb.	1/8½	¼d. dec.
p	White Anti-friction Metals— "White Ant" brand ..	per ton	£42 to £62	..
j	Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j	" 6 lea. Flax	per lb.	5½d.	..
j	" 8 ply 10 lbs. Russian ..	per lb.	4 15/16d.	..
j	" 10 lbs. Russian, single ..	per lb.	4½d.	..
j	" 180 lbs. Jute rove ..	per ton	£11	..
k	Zinc, Sh'ts (Vieille Montagne brd.)	per ton	£99 7 6	..

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co., *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

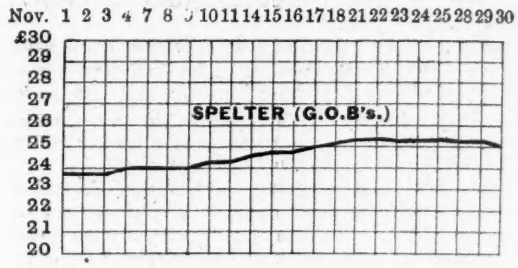
	Locality.	Week ending	Receipts for the week. £	*	No. wks.	Total to date. £	*	Miles open.	*
Elec. Trac.	Aberdeen	Dec. 3	1,099	+ 32	27	39,588	+ 5,771	10	—
	Bath	Nov. 20	450	—	49	30,677	—	12½	—
	Birmingham ..	Dec. 3	5,410	+ 521	49	263,465	+14,375	8½	—
	Blackburn	" 2	724	+ 30	35	34,141	+ 3,330	13½	—
	Blackpool	" 1	258	— 3	35	42,358	+ 5,902	8½	—
	" —Fleetw'd	" 3	182	— 71	22	20,606	+ 390	7½	—
	" —Lytham	" 1	119	— 19	5	606	—	7½	+ 2½
	Bolton	" 4	1,719	+152	36	66,668	+ 522	25	—
	Bournemouth ..	Nov. 30	706	— 28	35	39,758	—	10½	—
	Bradford	" 26	3,241	—108	33	158,540	+26,139	54	—
	Brighton	Dec. 4	720	+ 24	35	37,218	—	9	—
	Bristol	" 2	4,175	— 99	—	—	—	28	—
	Devonport ..	Nov. 25	404	— 27	47	25,102	+ 3,258	5	—
	Dudley—Sto'rb'ge	" 25	717	— 46	47	40,978	+ 1,367	18½	—
	Gateshead ..	" 25	863	— 7	47	42,868	+ 1,356	10½	+ 1½
	Gr'n'k—Pt. Glsgw	" 25	510	+ 7	47	27,279	+ 1,372	7½	—
	Oldham—Ashton	" 25	471	— 31	47	25,861	— 1,059	8	—
	Potteries	" 25	1,655	+130	47	80,978	+ 5,946	26½	—
	South Staffs. ..	" 25	610	—408	47	56,137	— 7,328	21¼	— 1½
	Swansea	" 25	447	— 3	47	25,556	+ 972	5½	—
	Wolverhampton ..	" 25	326	— 20	47	18,400	+ 582	10½	+8
	Yorks. Wool Dist.	" 25	432	— 55	47	27,526	+ 8,800	6	—
	Miscellaneous ..	" 25	2,581	—	47	172,654	—	—	—
Brit.	Burnley	Dec. 3	933	+159	—	—	—	10½	+2½
	Burton-on-Trent ..	" 4	274	+ 6	35¼	12,427	—	8½	—
	Cardiff	Nov. 26	1,704	— 89	34	70,997	+ 1,587	14	—
	Chatham & District	Dec. 1	434	—145	48	28,105	+ 2,170	9·58	—
	Cork	" 1	884	+127	48	24,512	— 2,612	9·89	—
	Dover	" 3	154	— 13	48	10,489	— 279	8	—

	Locality.	Week ending	Receipts for the week. £	*	No. wks.	Total to date. £	*	Miles open.	*
	Dublin	Dec. 2	4,356	+ 297	—	113,302	— 2,715	47	—
	East Ham	" 5	572	+ 48	35	25,846	+ 1,465	6½	—
	Glasgow	" 3	13,642	+500	27	385,743	+20,279	72½	+ 5
	Halifax (2 weeks) ..	Nov. 30	2,187	+ 29	35	53,084	+ 3,901	34½	+2¼
	Huddersfield	" 19	1,184	+ 78	33	46,296	+ 2,906	28	—
	Hull	Dec. 3	2,066	+261	35	77,567	+10,095	13	+2
	Ilkeston	Nov. 30	84	— 37	35	5,019	—	8·5	—
	Ipswich	Dec. 3	294	+160	35	17,650	—	10½	+6
	Isle of Thanet ..	" 3	283	+ 14	48	38,892	+ 1,627	10½	—
	Leeds	" 3	5,180	+325	96	269,916	+12,058	89½	+8½
	Liverpool	Nov. 26	9,273	— 309	48	497,179	+13,722	103	—
	London C. C. ..	" 19	12,093	+2918	34	429,634	+92,172	47½	+8½
	Manchester	Dec. 3	10,094	— 529	35	433,385	+18,081	137½	+12½
	Newcastle	Nov. 26	3,429	+ 3	—	—	—	17	—
	Portsmouth	Dec. 3	1,272	+ 71	35	71,672	+ 5,683	14½	—
	Salford	Nov. 28	3,322	—699	34	143,136	+ 7,560	30	—
	Sheffield	Dec. 4	4,387	+330	37	169,049	+ 3,405	34½	+1½
	Southampton ..	" 1	738	— 74	35	35,210	— 2,271	16½	—
	Southend-on-Sea ..	Nov. 30	193	+ 11	35	13,553	+ 1,361	6½	—
	Sunderland	Dec. 4	1,082	+ 36	35	45,629	+ 978	21	+1
	Tyneside	Nov. 30	305	+ 59	48	18,685	+ 3,122	8·9	+ 4
	West Ham	Dec. 1	930	—	40	36,727	—	9·78	—
	Wolverhampton ..	Nov. 30	642	+246	—	—	—	9·5	—
	Cen. London Rly. ..	Dec. 3	6,937	— 54	24	139,084	— 229	6	—
	City & S. Lon. Rly.	" 4	2,897	— 290	23	59,026	— 2,160	6½	—
	Dublin—Lucan Rly.	" 2	88	—3 2	22	2,824	— 32	6½	—
	G. N. and City Ry.	" 3	1,366	— 20	42	43,120	—	3½	—
	L'pool Overh'd Rly.	" 4	1,499	— 75	23	36,286	— 1,964	6½	+4½
	Mersey Railway ..	" 3	1,659	+188	22	32,581	+ 2,841	4½	—

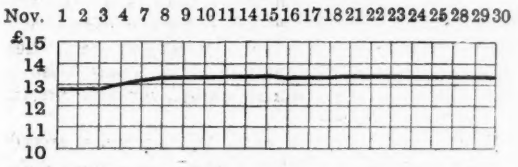
* Compared with the corresponding period of 1903.

METAL MARKET.

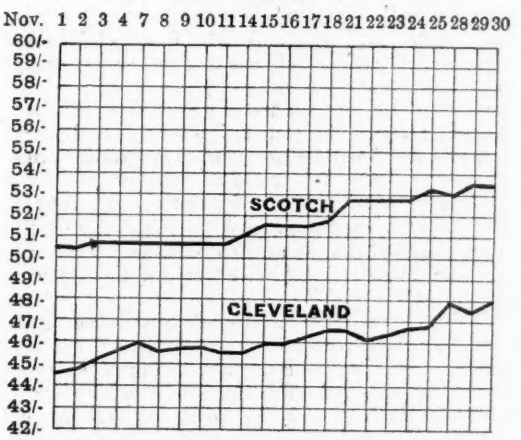
Fluctuations in November.



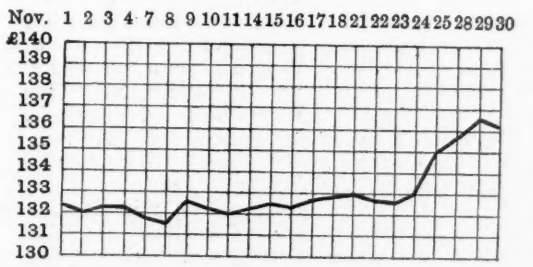
LEAD (ENGLISH).



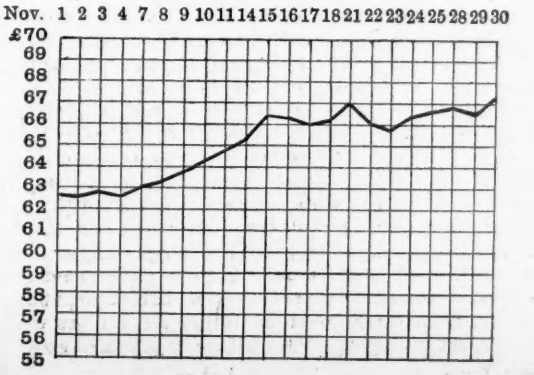
IRON.



TIN.



COPPER (G.M.B's.)



THE HOME OFFICE DRAFT REGULATIONS FOR THE USE OF ELECTRICITY IN FACTORIES AND WORKSHOPS.

By FRANK BROADBENT, M.I.E.E.

In inviting the writer to contribute a few notes on the proposed regulations of the Home Office for the use of electricity in factories and workshops, &c., the editors probably had in mind a paper he read before the Newcastle Section of the Institution of Electrical Engineers in 1901, entitled "Notes on Wiring Rules." The object of that paper, it may be remembered, was not to condemn all rules and regulations, but rather to plead for a uniform or standard set of rules, which, bearing the official imprimatur of the Institution of Electrical Engineers, should be recognised and accepted in principle by fire offices, station engineers, architects and consulting engineers. Happily this condition of things has since come to pass.

What were known generally as the "Board of Trade Rules" for 400-volt work were, at that time, in existence, and they have continued till now without material modification.

In effect, these rules call for the complete enclosure, where practicable, of all cables, switches, fuses and motors in strong metal casings in such a manner as to prevent shock or fire risk, such casings to be "earthed." The practical application of the rules has been that in indoor work on 400-volt circuits, the cables have been run in screwed iron piping, and the switches and fuses have been enclosed or protected in cast or sheet-iron cases.

The rule that positive and negative switches should be kept 6 ft. apart, has been generally ignored. It is quite an impracticable rule. Apart from one or two impracticable requirements such as the above, there is very little to which exception can be taken in the Board of Trade Regulations, as regulations; but they have had the effect of very seriously handicapping the better class of electrical contractors, who, having loyally attempted to comply as far as possible with the spirit of them, have had to compete with others who, knowing that the Board of Trade had practically no jurisdiction in a building beyond the Supply Co.'s terminals, put in work which had it been officially inspected, would have most assuredly been condemned. It is this total lack of supervision or inspection—rather than the rules themselves—which forms the chief objection to the Board of Trade Rules. There is no inspector to say what is, or is not, in compliance with the rules.

As showing the uncertainty which exists as to the true interpretation of the rules, the item of switches might be instanced. While some makers and contractors assume a cast-iron enclosing box to be required, into which the pipes carrying the cables are to be screwed, others think the conditions are satisfactorily met if live contacts are protected with a thin sheet-iron cover, in which there are open slots for the handle an inch or more wide. In the latter case the pipes finish *somewhere near* the switch, and the cables are coiled into pretty spirals outside the case. The same artistic arrangement is followed at the fuse-boxes and motors.

Then, the method of earthing the motors, piping and boxes is very haphazard. As a rule, it is left to the discretion of the wireman, and generally consists of a bare No. 16 wire fixed under a screw-head, or lapped two or three times round a pipe, with occasionally a crude attempt at soldering thereto. Sometimes an insulated wire is used—a somewhat unsafe method, from a fire risk point of view. An instance of fire having been caused by the overheating of an insulated earthing wire, has been previously described by the writer in the columns of the Electrical Review. It may be recalled that in the instance referred to the consumer's main switches were "off," and there was no current whatever passing through his meter or fuses.

Whatever may be the general opinion as to the value of the Board of Trade regulations as a preventitive of fire or

shock, when such regulations are observed, there is no question but that the making of rules, which are intended to be complied with, but which no authority has the power to enforce, puts the honest contractor at a disadvantage and at the mercy of the Cheap Jack.

The weak point in any argument in favour of the Board of Trade requirements, is that the existing regulations apply only to installations connected to public supply mains and not to isolated installations. Now, if 400 volts is a dangerous pressure, the danger is not less if the electricity is generated within the works than if taken from a public service.

This is one of the points which has been recognised by the Home Office, and it is proposed now to make rules or regulations, for the use of electricity (at pressures exceeding 250 volts) in factories and other places which come under the Factory and Workshop Acts, no matter how or where the electricity is generated.

Coming now to the draft regulations themselves, these are based on the existing Board of Trade regulations "without any addition, except by way of relaxation." Any criticisms directed against these regulations will apply, therefore, with equal force to those of the Board of Trade. In order that the differences between the proposed Home Office Regulations and those of the Board of Trade may be readily seen, the two sets of rules are here given in parallel columns :—

Proposed Home Office Regulations for Pressures between 250 and 650 Volts.	*Board of Trade Regulations for Pressures Exceeding 250 Volts.*
1. "All wires in connection with the supply shall, where practicable, be completely enclosed in strong metal casing, and where this is not practicable they shall be so arranged that there shall be no danger of any shock or of fire."	2. "The electric lines forming the connections to motors, or otherwise in connection with this supply, and placed on the aforesaid premises of the consumers, shall be, as far as practicable, completely enclosed in strong metal casing efficiently connected with earth."

It will be seen that the sense of the two rules is identical, the only differences, apart from literal variations, being (1) that whilst the Board of Trade regulation applies to "consumers," that of the Home Office omits this term, its application being general ; and (2) no mention is made in the Home Office condition as to "earthing." This point is, however, the subject of a further special regulation.

The troubles that are likely to arise in connection with this regulation are (1) in the interpretation of the expression "where practicable," and (2) in the differences of opinion on the question, "What constitutes a complete metallic enclosure?" The Board of Trade regulations were obviously intended originally to apply to covered-in buildings, such as one usually associates with the terms "factory" and "workshop." Such places as dockyards, wharves, shipyards, chemical works, quarries and the like were, at the time when these regulations were drawn up, not thought of as likely "consumers" of electricity from a public supply station. But the great reductions that have recently been made in the price of electricity for power purposes, have brought many such places within the public supply authorities' "sphere of influence." Again, the popularising of three-phase work for isolated power and lighting installations, brought with it a tendency to higher pressures than the erstwhile continuous current standard of 230 volts. With a three-phase system it became possible to supply, from one generator, motors at 400 volts and lighting at 230 volts—a much simpler system to work than the three-wire continuous current system at, say, 230—460 volts. The adoption of 400 volts for three-phase installations made it necessary for continuous current advocates to raise their pressures in order to compete in price, with the result that there are now thousands of installations carrying pressures of 400 volts and upwards.

It goes without saying that the higher pressure demands a better quality of work than is necessary at the lower one, but in the absence of any expert supervision, the contractor, who generally secures his work by being the cheapest tenderer, makes no distinction. If he is accustomed to 100-volt work, then it is practically a 100-volt quality job that goes in, and the Board of Trade rules are practically ignored, once the supply fuses are passed. To show that this is not a groundless assumption, it is enough to quote—not to mention one's own personal experience in the supervision of installations—the *Home Office Circular*, date October 15th, 1904, covering the proposed regulations : "instances have been brought to the notice of the Secretary of State in which failure to observe the conditions laid down by the Board, has resulted in serious, and sometimes fatal accidents to persons employed in places under the Factory Act."

To return now to the consideration of the first regulation. It appears to be taken for granted, judging from correspondence in the technical Press, that the expression "completely enclosed in strong metal casing" necessarily means "metal tubing," and the objections, which, under certain conditions, apply to this method of wiring have been emphasised.

These objections are given as "inaccessibility of conductors, difficulty in maintaining satisfactory insulation, owing to condensation of moisture in the tubing, difficulty of inspection and of the localisation and remedying of faults in the conductors, and increased first cost." But, after all, we can scarcely blame the Home Office for seeking to enforce a rule which is based on one of the rules of the Institution of Electrical Engineers, the only difference being that the Home Office rule is much more lenient and open. Let us compare the Home Office and Board of Trade rules previously mentioned, with the following, which is No. 12 of the Institution rules :—

"Conductors conveying currents at pressures exceeding 250 volts must be completely enclosed in strong metallic sheathing or tubing efficiently connected to earth, and such sheathing or tubing must be electrically continuous throughout its length." This rule leaves no such loophole as "where practicable," and, unlike the Board of Trade rule, it is intended to apply to all installations, whether supplied from an external source or not.

It would appear then, that the Home Office officials will have a very powerful reply to any objection urged against their first rule. They can say, "We have taken a rule recommended by the Institution of Electrical Engineers, drawn up by a committee of electrical experts assisted by borough electrical engineers and practical electrical men engaged in installation work, and what they have recommended we intend to enforce—with certain modifications 'by way of relaxation.'"

The Institution rule simply defines what is now, among the contractors of recognised standing, the regular standard practice for *indoor* work on circuits carrying pressures exceeding 250 volts, and no responsible contracting firm would think of objecting to its enforcement, unless there were special conditions which made it undesirable or impracticable ; for which conditions provision seems to be made in the Home Office rule. But when we consider large engineering works and outdoor, or semi-outdoor work, such as the open sheds in shipyards, chemical works and quarries, and on quays or wharves, the conditions do not lend themselves to metal piping work. As a rule, installations in such places involve the transmission and distribution of electric power over considerable areas, and apart from the question of cost, it is quite impracticable to run heavy overhead mains in piping. It is also often just as impracticable to run them underground, as anyone who is familiar with this class of work knows well. But is iron piping the only means of complying with the rule, where such compliance is really necessary ?

In the open air there is, of course, little or no fire risk from overhead conductors on insulators, and no more risk of shock than from a trolley wire ; much less, in fact. The same holds good for conductors fixed on insulators, well out of reach under shed roofs. Where they are within reach, or where there might be a danger of accident in the event of a wire breaking or falling from an insulator—a most unlikely contingency—sufficient protection would be afforded by an earthed guard of stout wire netting or expanded metal hung underneath and parallel with the cables. If necessary the guard could be made to enclose the cables at the sides. Where it is possible for a person to fall against the conductors, a stout sheet-iron guard or cover partially or wholly surrounding them would meet the case ; the guard to be earthed, of course. There is clearly a need for amplification of the rule to cover power distribution installations of this nature, and arc lighting installations at pressures exceeding 250 volts.

Touching the second rule, which reads "All main and branch circuits shall be protected by switches, and by fuses or other automatic cut-outs," it has been objected that when a suitably designed automatic circuit breaker is used, there is no need for a switch in series with it. There is some reason in this, and it is desirable to reduce as far as possible the number of joints or points of contact in any circuit, as these are all possible sources of leakage and fire risk. It might be successfully argued that as an automatic circuit breaker is both a switch and an automatic cut-out, it, therefore, complies with the rule. The same reasoning holds good for the type of fuse known as a "switch-fuse." That is the type in which a pair of switch contacts connected together by a fuse, are mounted on a porcelain handle, effectively shielding the hand from accidental contact. The fuse should preferably be of the enclosed type. There is little doubt but that for branch circuits, the Home Office officials would accept these as fulfilling the requirements of the second rule. The existing Board of Trade rule calls for fuses or automatic cut outs on branch circuits.

The differences between the Home Office and Board of Trade rules relating to switches on motor and arc lighting circuits are shown below.

Home Office Proposed Rule.	*Existing Board of Trade Rule.*
3. The supply to every motor or arc lamp shall be controlled by means of an efficient switch, so placed as to be easily handled by the person in charge of the motor or arc lighting, and connected, so that by its means all pressure can be cut off from the motor or arc lamp, and from any regulating switch resistance or other device in connection therewith: provided, however, that where the arc lamps are connected in series across the outer conductors of a 3-wire system and the pressure cannot exceed 250 volts from earth, it shall be sufficient if one such switch be provided for each series of arc lamps.	**3. The supply to every motor shall be controlled by means of an efficient cut-off switch, placed in such a position as to be easily handled by the person in charge of the motor, and connected, so that by its means all pressure can be cut off from the motor itself, and from any regulating switch resistance or other device in connection therewith.**

The essential difference in the above, is that the Home Office rule will apply to arc lighting circuits, whilst the Board of Trade rule touches motors only, although series arc lighting in works, at pressures exceeding 250 volts, was quite common prior to the date of these rules.

It has been objected that a separate switch to each lamp is unnecessary, and adds greatly to the expense and complication of the wiring.

If the rule implies that each lamp is to be controlled by means of an isolating switch fixed at a distance from the lamp itself, this objection is certainly a sound one.

In many cases it involves not only a double-pole switch, but also a substitutional resistance. Where it is necessary to re-carbon, or otherwise attend to the lamps whilst current is on the circuit, there is, of course, some risk of shock if the lamp is not isolated. But in ordinary cases it is not necessary. It is, however, not at all uncommon for arc lamps to be provided with isolating switches and substitutional resistances, the switches in many cases being designed to isolate the lamp automatically in the event of extinction. The switch and resistance are not necessarily separate from the lamp, but combined with them. If this be allowed, the objection *re* complicated wiring does not hold. The rule would, nevertheless, need a little modification, for, as at present worded, it precludes the use of substitutional resistances, which would come within the scope of the expression "resistance or other device in connection therewith."

Rule 4 is identical with a section of the third Board of Trade rule, and reads as follows:—"All switches and cut-outs shall be so enclosed and protected, or be in such positions or of such construction that there shall be no danger of any shock being obtained in the ordinary handling thereof, or of any fire being caused by their normal or abnormal action." So far as switches are concerned, there are a good many very satisfactory makes of enclosed switch which meet the requirements; and, on the other hand, there are many fitted with what is called "a Board of Trade protective cover," which do not fulfil the conditions at all, as they are neither shock-proof nor fire-proof. Neither does the enclosed switch, in which it is necessary to open a door, thus exposing live metal in order to operate the switch, meet the case. As regards fuses, there is scarcely one besides the shielded porcelain handle type—that is the switch-fuse which really complies with the spirit of the rule. The ordinary tubular clip fuse with metal end caps, which is so largely used for 400-volt work, does not meet the requirements, although it would not be a difficult matter to make it do so by the provision of insulating caps and flanges. The old-fashioned screwed terminals and open fuse wire, although still used for medium voltage work, cannot be said to comply in any way with the requirement. The fuse question is really one of the most important, as more accidents, both from fire and shock, are due to this cause than to any other.

The fifth rule calls for the earthing of all metal casings of wires, motors, switches, fuses and incandescent lampholders.

This includes all that is required by the Board of Trade, with the addition of lampholders. Objection has been raised to the inclusion of lampholders in this clause. It is argued that the earthing of incandescent lampholders would increase the cost of factory installations to a prohibitive extent, owing to the necessity of an earth wire, and would entirely preclude the use of plain pendant fittings. It is further objected that on an earthed neutral system the full potential between the outers of the three-wire system would exist between the fitting and earth in the event of an earth occurring on the metal work of the fitting. The meaning of this is somewhat obscure, for if the fitting were permanently earthed, an accidental earth on it would have no effect whatever. If, however, accidental contact with a live conductor is meant, the fuse would blow, owing to the fitting being earthed. It is only if the fitting is *not* connected with earth that it could acquire a dangerous potential. Further, whatever is meant precisely, it is surely impossible to get the full difference of potential of the outers between any point and earth in an earthed neutral system. On the general question, there is good reason for requiring the earthing of metal lampholders on high potential circuits, although the use of more than 250 volts on a single incandescent lamp, is a somewhat remote contingency. Possibly series lighting is contemplated. In a concrete, that is a fireproof, factory containing machinery, practically everything tangible is earth, and a leak, say from a strand of the flex to a lampholder not permanently earthed, might easily be the cause of serious accident due to shock. As the wiring would be in earthed tubing, the earthing of holders would not cost 1d. a light. It means simply a triple flexible cord, consisting of two insulated conductors, and one either bare or braided. There is nothing to prevent porcelain lampholders being used, and this would get over the objection. The Manchester Corporation rules call for porcelain holders under the conditions named. [The rules originally drawn up by Mr. Wordingham are here referred to.]

The Home Office rule might, indeed, be made more comprehensive, and include arc lamp cases, and all metal cases of heating and cooking appliances. The earthing of the latter as required by the Manchester Corporation rules was criticised by the writer in his Institution paper on Wiring Rules in 1901, but the criticism would not apply when pressures exceeding 250 volts are used.

The sixth rule appears to refer to service lines and apparatus under the control of the supply authority, and the only objection that is likely to be raised, is that raised by the Chamber of Commerce (Electrical Section) as to the giving of annual certificates to the consumer that the regulations have been complied with.

The chief objection to the proposed regulations, from the general standpoint, is that they do not go far enough.

If rules are to be enforced at all (and the writer's view has always been that rules which cannot be enforced are far more objectionable) it is no use half doing it. A "more complete code" is promised in the *Home Office Circular*. To make an occupier or consumer responsible for the observance of rules which do not cover the whole requirements of his installation is to give him a false sense of security, and supply and insurance companies will have increased difficulty in obtaining compliance with their rules, as, on

the face of things, it will seem reasonable to say, "We have complied with the Home Office requirements, and that should satisfy you." But will it?

INSTITUTION OF ELECTRICAL ENGINEERS.

THE USE OF IRON IN ALTERNATE-CURRENT INSTRUMENTS.

Abstract of inaugural address delivered to the Birmingham Local Section by the chairman, W. E. Sumpner, D.Sc., on November 23rd, 1904.

It is probably no exaggeration to state that the amount of time, ingenuity, and skill, devoted during the last 10 years to the improvement of alternate-current instruments, has exceeded that spent in perfecting those for direct-current measurements during a period more than twice as long. Yet no one will maintain that the result is anything like so satisfactory in the former case as in the latter. It will, I hope, be interesting to spend some time in considering the reasons for this, and what prospect there may be of a better result in the future.

The idea that alternate-current measurements are more complicated than those with steady currents, and that in consequence the tests are not likely to be so accurate, I believe to be entirely wrong. It is not so much in the nature of the measurements to be made, as in the character of the instruments available for the tests, that the difference really lies. The result, I believe, is almost entirely due to the fact that for alternate currents there is no instrument at all comparable in sensitiveness with the galvanometers and voltmeters available for steady current work. Indeed, the sensitive voltmeter seems the one common essential to all accurate electrical testing.

It is, of course, to the use of permanently magnetised steel that direct-current instruments owe their great sensitiveness. Whether of the fixed coil or moving coil types, galvanometers may be described as single-current instruments in which the deflecting force is proportional directly to the current or voltage applied. Unfortunately, all alternate-current instruments have the characteristics of the double-current type, in which the deflecting force is proportional to the square of the current or voltage. Instruments in which the deflecting force varies as the square of the applied voltage cannot be made sensitive for minute voltages, owing to the rapid diminution of the force as the voltage decreases, and this constitutes the main reason why alternate-current instruments cannot be made to indicate low voltages.

An instrument may be made sensitive either by weakening the control, or by increasing the forces causing the deflection. In order to make alternate current instruments as sensitive as the corresponding direct-current ones, strong magnetic fields must be produced. The permanent magnet is useless for alternate-current work, but the electro-magnet still remains a possibility. The problem of producing sensitive alternate-current instruments resolves itself, therefore, into an inquiry into the conditions under which iron-cored electro-magnets may be introduced into such instruments without involving errors due to differences of phase, frequency, wave-form, and other disturbing factors.

As an example of the need for more sensitive alternate-current instruments, I may instance the important problem of directly measuring an alternate current, or voltage, in terms of direct-current standards, such as a known resistance, and the electromotive force of a standard cell. Some years ago I tried to find a means of using the Crompton potentiometer for the direct measurement of an alternate-current voltage in terms of a standard cell. I soon saw how this could theoretically be done, but I have not succeeded in making or in finding an instrument sensitive enough to satisfactorily carry out the test.

Nevertheless, the mere invention of a sensitive dynamometer voltmeter would at once render the Crompton potentiometer, as now made, as suitable for the measurement of alternating currents and voltages as of the corresponding direct-current quantities for which it is so useful.

Now before discussing how to use iron in alternating-current instruments, it must first be stated that this is already done in many cases, as in moving-iron indicators, and in instruments of the eddy-current type. The latter now form an important class, and are either of the shielded pole type, the outcome of some pioneer experiments of Elihu Thomson, or of the rotary field type due originally to Ferraris. The rotating field instruments are particularly useful. They have the great advantage that the geometrical relations of the fixed and moving parts are not changed as the disk or cylinder turns, so that the indicating instruments possess regularly divided scales, and a range of deflection extending to nearly 360°. Such instruments have many undoubted merits, but their calibration varies with frequency, and to a slight extent with wave-form. The wattmeters of this class are indeed not much more than good indicators. They are not the less useful on that account. They fulfil all the requirements of central station use, but for accurate measurement something more is needed.

The first instrument to which I wish to direct your attention is the phasemeter, or power-factor indicator. These instruments may be made for either single or multiphase circuits. In the former case the calibration depends somewhat on the frequency, but only very slightly so in the latter. All such instruments consist of a fixed and moving set of coils, having a common diameter about which the moving system turns. There is no control except that due to the interaction of the currents. Each system may comprise more than one coil, but as a rule the fixed system consists of a single coil through which the current passes, while the movable system consists of two coils inclined at some fixed angle to each other, and traversed by currents in different phases, obtained usually by tapping the multiphase mains, but, in the case of single-phase circuits, by providing two paths of different inductive properties for the pressure currents needed for the coils.

Now, in the theory of these instruments as hitherto given, the action of the current in the fixed coil on that of each of the moving coils is separately considered. Two moments are exerted, one on each moving coil, and the position of balance indicated by the pointer is such that these moments are equal and opposite. This position is independent of the amperes, or volts. The position of balance can therefore only depend upon the phase differences between volts and amperes, and hence the deflection of the pointer can be calibrated to indicate phase.

But there is another way of looking at the action which is useful to consider, and which I think has not been previously noticed. The two-coil system traversed by currents in different phase produces a rotating field, and the interaction between this and the alternating (or rotating) field due to the current (or currents) in the other system of coils must be such that there is only one stable position of the moving system of coils for which the torque vanishes, and this position can only depend upon the phase differences involved in the two systems of currents.

Now imagine a coil traversed by an alternating current placed in a rotating magnetic field of the same frequency, and free to turn about the axis of rotation of this field. The position taken up by the coil depends merely upon the phase of the current through the coil. If we assume uniformly revolving fields, and currents varying according to the sine law, the position will be such that at the instant the rotating field is parallel to the coil, the current in the latter is passing through its zero value. The angular deflection of the pointer from some fixed point on the scale measured in degrees, will be an exact measure of the phase of the current. If the currents are of irregular wave-form, and the rotating field is not uniform, this will not be precisely the case (see Appendix), but there will in all cases be a fixed position of the coil for each phase, independent of the magnitudes of the currents in the different coils, and quite independent of the frequency, since this will affect currents and fields alike. The most efficient way of producing strong rotating fields is of course well known. It is exemplified in every induction motor. But it does not appear to have been noticed hitherto that phasemeters really act by means of rotating fields, and hence the means adopted in practice for producing such fields in commercial instruments are anything but the best available.

To illustrate this and other points I have had some instruments constructed in the Technical School workshops, all designed for strong alternating magnetic fields. The first is a phasemeter. The fixed coils are wound through circular ring stampings just as in the stator of a three-phase motor. There are three coils, each of eight turns, wound with wire suitable for 5 or 6 amperes, with each coil brought to a separate pair of terminals. The portion corresponding with the rotor consists of a cylindrical block of circular stampings held in a fixed central position and unwound. In the air-gap between the two is placed a pivoted coil similar to those used on moving-coil galvanometers or voltmeters, but without control. It is capable of free motion about the axis of the instrument, and its position is indicated on the scale by an attached pointer. This instrument is a very satisfactory indicator of phase or power-factor. The position taken up by the pointer is quite definite under any given circumstances, and if the coil is moved out of its equilibrium position the forces tending to make it return are considerable, in spite of the fact that a very large non-inductive resistance is used in series with the pressure coil. This is only what is to be expected, since the strength of the field due to the fixed coils is about equal to that usual in permanent magnet direct-current instruments. Here, at all events, is one alternating-current instrument in which strong fields are employed, without any of the disadvantages and errors supposed to be associated with the use of iron under such circumstances. Of course, it would be possible to wind the fixed coils for pressure instead of current, either for direct connection to the mains, or, if necessary, for the secondary of a step-down transformer. In many cases the moving coil would be put in series with the secondary of a current transformer. It is usual now, with high-tension mains, to have two current transformers, each primary being placed in one of the mains, and each secondary circuit, after passing through an ammeter, returning through a path common to both secondary circuits, and in which an ammeter and power-factor indicator are placed. The connections are shown diagrammatically in fig. 1, in which A_1, A_2, A_3 represent the ammeters, (1), (2) and (3) indicate the mains, in the first two of which the primaries of the current transformers C T_1 and C T_2 are placed, and the power-factor indicator is represented by P.F.I. Owing to the vector properties of alternating currents, if the current transformers are alike, the current measured by the ammeter A_3 will indicate the current in the third main, as shown by the vector diagram in fig. 2. With such an arrangement, it would be advantageous to use a reversing switch (short-circuiting during reversal) on the secondary of one of the transformers, say C. T., as indicated in fig. 1. By reversing this switch A_2 is unaltered, A_1 becomes A'_1, equal but opposite in phase to A_1, and A_3 becomes A'_3, about 70 per cent. greater than A_3 in magnitude, and strictly in quadrature with it, whatever the wave-form may be, provided only A_1 and A_2 are equal in magnitude. These relations are shown in the

vector diagram, fig. 2, in which, owing to the properties of a right-angled triangle, A'_2 is perpendicular to A_3, if A_1, A'_1 and A_2 are equal to each other, whatever may be the phase difference between A_1 and A_3. The advantage of this device arises from the fact that the power-factor indicator can be made to read on circuits of low

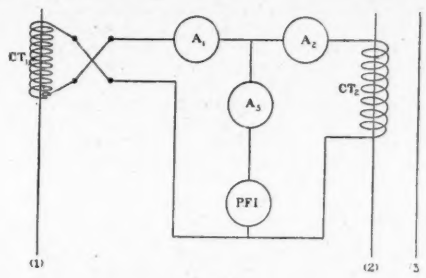


Fig. 1.

power factor as well as on those of high power-factor. As a rule, these instruments are calibrated between power-factors 0·5 and 1·0, and are not available for low power-factor circuits. By using the reversing switch, the phase of the current passing through the instrument can be altered by 90 electrical degrees, so that the position corresponding with unity power-factor is made to denote zero power-factor, and, by means of an additional calibration of the scale, low power-factors can be measured. If satisfactory power-factor indicators can be constructed, they will prove more serviceable than wattmeters on highly inductive circuits, since the latter instruments under such conditions are liable to large percentage errors, and their indications are low down on the scale.

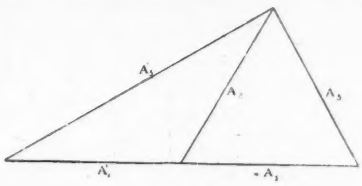


Fig. 2.

I now pass to the consideration of wattmeters. The introduction of electro-magnets into these instruments is naturally a more difficult problem. With the exception of electrostatic instruments, all accurate wattmeters are of the dynamometer type. Iron, and indeed all metal parts, are severely excluded, with the result that these instruments are insensitive, lacking in range, and subject to disturbances caused by external fields. It has, nevertheless, become necessary to use transformers in conjunction with them, owing to the high potentials and heavy currents now common. These accessories, of course, contain iron, and introduce errors, due to small differences in phase, which are as serious, I believe, as those which would arise from the use of well-designed electro-magnets in the wattmeter itself.

The error in wattmeters due to the lag of current in the pressure coil has frequently been theorised about, but I think a somewhat exaggerated idea exists as to its nature and extent.

The error in the reading, instead of indefinitely increasing as the power-factor diminishes, rapidly attains a maximum value, which is less than 2 per cent. of the reading corresponding with the same current if non-inductive.

The lag in the pressure coil can be easily reduced to one-tenth of a degree, and the error caused by it is proportionately diminished. It is not so well-known that the phase differences introduced by

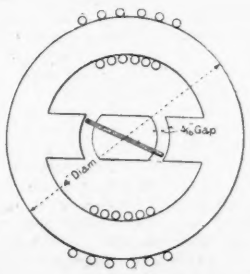


Fig. 3.

current and voltage transformers can, if these are properly designed, be reduced to similar small values. Of course, the errors due to such phase differences are of the same nature and importance as if they were all due to lag in the pressure coil.

Electro-magnets may be introduced into wattmeters either by putting the magnetising coil in series with the current, or by connecting it in shunt across the mains. In the former case, owing to hysteresis, eddy currents, and varying permeability, the induced magnetism will not properly follow the variations of the current, even when the magnetic circuit contains an air-gap, and only low magnetic densities are needed. On the other hand, if a shunt coil is used to produce the magnetism, not only is there an error due to the resistance of the coil, but the flux of magnetism is practically in quadrature with the voltage producing it. The resulting errors can, perhaps, be made negligible in either case, but it is the latter method I have tried experimentally lately, in order to bring the question before you.

If N is the magnetic flux in the core of a transformer or electro-magnet produced by a current C through a winding of n_1 turns of resistance R, the voltage V_1 necessary to produce this current is given by—

$$V_1 = R\,C + n_1 \frac{dN}{dt}$$

The effect of hysteresis, eddy currents, and variable permeability is to alter the R C term; but if we assume that by suitable design this term R C can be made negligible compared with V_1, we have—

$$V_1 = n_1 \frac{dN}{dt},$$

and hence, whatever the nature of the iron, the strength of the flux N, and therefore the magnetic density in each part of the air-gap, is strictly proportional to V_1, and in perfect quadrature with it. If now the load current A be passed through the primary of an air-core transformer (shielded if necessary from external fields by a shell of suitably laminated iron), the voltage induced in the

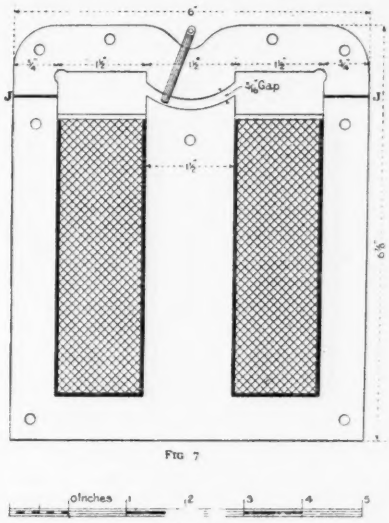


Fig. 4.

secondary coil will be proportional to A in magnitude, and in quadrature with it as regards phase. It may thus be used to produce a minute current a through a large non-inductive resistance and the moving coil of the instrument. Theory then shows that if a is in quadrature with A, and if N is in quadrature with V_1, the torque on the moving coil is proportional to the average value of the product $V_1 A$ and therefore measures watts, independently of frequency and wave-form, and of the nature of the iron used in the electro-magnet.

The first instrument using this principle which I had made was of the reflecting type. I have since constructed two non-reflecting instruments (illustrated in figs. 3 and 4) which I now show you. In each of these instruments the moving coil is exactly similar to those used in commercial moving-coil instruments for direct currents. They are pivoted and controlled by helical springs of the usual kind. The magnetic circuits are indicated in the figures. That of the earlier instrument is of the Manchester dynamo type, and contains two air-gaps. The latter instrument has a magnet of the Lahmeyer type, but arranged to have only one air-gap, the moving coil turning about an axis coincident with one of the long sides of the coil, and placed outside the magnetic field, the opposite side moving through the air-gap. The magnetic circuit is jointed along the line, J J, to allow of the insertion of the coils. By winding the magnetising coil on the centre limb as in fig. 4, instead of on the two side limbs as in fig. 3, the effect of an ampere-turn is doubled, and by reducing the number of air-gaps from two to one the effect is again doubled. To further reduce the copper drop, C R, as compared with V_1, the voltage on the magnetising coil, this coil should be liberally supplied with copper, and should fill as much winding space as possible. Of course the air-gap should be a minimum. In the instruments shown, each air-gap is $\frac{3}{16}$ths of an inch across. It is quite possible to halve this, and still allow plenty of room for the free movement of the coil.

The calibration curve of the instrument outlined in fig. 6 was tested by passing direct currents through the fixed and moving coils. For magnetising currents producing air-gap densities similar to those found in direct-current moving-coil instruments, the calibration curve obtained by varying the current in the moving coil was always of the same shape. When the deflection was interpreted by means of this calibration curve the reading was found strictly pro-

portional to the product of the currents in the two coils. The instrument was then tested with alternate currents against a standard wattmeter on a non-inductive load of lamps. A voltage transformer was used to reduce the voltage of the circuit to one suitable for the instrument. The minute current through the moving coil (having 50 turns and 6 ohms resistance) used in series with a non-inductive resistance of 300 ohms, was taken from a few turns of thin wire forming the secondary of a small iron-cored transformer, the primary of which consisted of two turns carrying the load current. The experiments showed that the calibration curve, or the relation between deflection in degrees, and watts, was exactly the same as that obtained with direct currents, the load being non-inductive throughout the tests. When the power-factor of the load was suddenly altered from 1·0 to about 0·1 it was, however, found that the constant of the instrument was considerably changed. This result was due partly to the fact that the copper drop in the magnetising coil was not negligible compared with the applied voltage, but it was also largely due to the phase differences introduced by the two transformers, each of which had a closed iron magnetic circuit. These transformers were indeed quite unsuited for the purpose, and the copper drop in the magnetising coil of the instrument was (at 40 cycles) about 20 per cent. of the total voltage applied. But even under these circumstances the deflection of the moving coil, as interpreted by the calibration curve obtained with direct currents, was strictly proportional to the watts for a load constant in power-factor and frequency.

No further experiments were made on this instrument, which was constructed simply out of such stampings as were to hand, while awaiting the arrival of special stampings ordered for the instrument shown in fig. 4. In this instrument much more space was allowed for the magnetising coil, and in other ways already mentioned the construction was modified with the view of reducing the copper drop. The magnetising coil consists of 1,051 turns, having a resistance of 3·68 ohms. The section of the middle limb of the magnetic circuit is a trifle over 2 sq. in. The moving coil consists of about 60 turns, having a resistance of 5·4 ohms. The moving coil can turn through an angle of 80° without leaving the field. The copper drop is only 0·88 per cent. of the applied voltage when the frequency of the current is 80. This means that the phase of the applied voltage cannot differ from that of the induced voltage due to the flux in the coil by more than half a degree, and if there are hysteresis losses, this phase difference will not be increased but diminished. The losses in the magnetising coil are quite trifling, and the iron losses must be small. For the current transformer for this instrument I have simply wound a coil of 10 turns so as to surround a secondary coil of about 600 turns, no iron being used.

Several tests on the instrument were made with a resistance of 500 ohms in series with the moving coil and the current transformer. The calibration curve was first found by taking two sets of tests with direct currents. In one of these the magnetising current used was kept constant at 0·10 ampere, and in the other set it was made 0·15 ampere. Various currents were passed through the moving coil, and the corresponding deflection in degrees shown by the pointer was noted. When the product of the two currents, each measured in milliamperes, was 1,006, a deflection of 50° was obtained. Both sets of points lie well on the same curve. Six sets of tests with alternating currents were then made on loads of different power-factor, but with the current frequency kept constant at about 80 cycles, the voltage of the circuit in all cases being about 60. It appears from these tests, and from numerous others which I have made, that the same calibration curve holds for the instrument under all circumstances, or, in other words, that for a specially-prepared scale determined from this calibration curve the reading of the pointer will be proportional to watts for a varying load of any fixed power-factor and frequency. The constant of the instrument does change to some extent for alterations of frequency and power-factor. The constant for unity power-factor loads differs by about 4 per cent. from that for loads of power-factor 0·6, and by about 8 per cent. from that for loads of 0·3 power-factor. The main part of the alteration of constant is caused by the current transformer, which was not specially designed for the purpose. For non-inductive loads traversed by currents, the frequency of which varied from 93 cycles to 43 cycles, the alteration of the constant was 1·4 per cent. Similar tests made with a resistance of 750 ohms in the transformer circuit, showed a change of constant of less than 1·0 per cent. for frequencies varying between 100 cycles and 45 cycles. A set of tests on the effect of power-factor made with this resistance in series with the moving coil, and at a frequency of 80 cycles, showed no measurable alteration of constant for power-factors ranging between 1·0 and 0·1. Of course, there must have been some error, but much less than in the previous tests.

Now, in my opinion, no wattmeter should be considered a satisfactory instrument if it has errors like some of those mentioned, though it will hardly be denied that many commercial instruments present greater errors in practice. The chief importance attaching to the tests referred to is due to the light they throw upon the question of the possibility of constructing good wattmeters with iron-cored electro-magnets.

I foresee no difficulty in rendering negligible the error due to the transformer, and the instrument itself can be much improved upon.

If it be once granted that the errors can be rendered sufficiently small, no one will doubt the great advantage of an iron-cored instrument, or dispute its supremacy in regard to sensitive qualities. It must necessarily be as delicate as a permanent magnet moving-coil instrument, since the magnetic field can easily be made as strong, or even stronger. In order to investigate the action of transformers for instrument purposes, I have devised voltmeter methods for measuring small phase differences, and I have set forth in Table II. the results of a number of recent measurements. In carrying out these tests I have had the benefit of the able assistance of my colleague, Mr. David Owen. The phase differences measured are given in the column headed θ. The last column shows for the smaller values of θ the number of parts in *one million* by which $\cos\theta$ differs from unity. The first number given relates to a common water resistance, and implies that its power-factor may be taken as 0·999978. This should bring comfort to any one who has doubted the non-inductiveness of such resistances. The values of θ given for the wire spiral and for the direct-current arc are the minimum values I could detect with certainty with the voltmeters I had at disposal when the tests were made; consequently all that these numbers prove is that the power-factor in these cases does not differ from unity by more than corresponds with the figures given. Then follow a number of tests on voltage transformers of various capacities, with the secondaries in some cases on open circuit, and in others supplying currents of various magnitudes and power-factors. The last three tests were on current transformers with secondaries closed on the circuits for which they were designed. It will be noticed how exceedingly small the value of θ is for some of the transformers on open circuit. This is of special interest in regard to electro-magnets for wattmeters, since such electro-magnets are essentially transformers on open circuit, and the phase difference measured is that caused by the copper drop in the magnetising coil. For the one unit, equal ratio, transformer this value of θ is only 0·02°, and $\cos\theta$ differs from unity by less than 7 parts in *one hundred million*. On full load θ is only one-third of a degree, and is much the same for a load of power-factor 0·09 as for unity power-factor. The three-unit transformer shows a lower phase

TABLE II.

Apparatus tested.	Load. Amps.	Load. P.F.	Phase tested of	θ (degrees).	$10^8 \times (1-\cos\theta)$.
Lead plates in weak acid ...	8	—	V_1, A	0·38	22
Platinoid wire spiral	7	—	,,	0·27	11
Direct-current arc	8	—	,,	0·17	4·5
0·1 unit Tr. at full voltage ...	0	—	V_1, V_2	0·34	17
1·0 unit Tr. for 50 V_1 to 50 V_2	0	—	,,	0·021	·068
,, ,, ,,	21	1·0	,,	0·34	17
(All tests at 80 cycles and 70 volts)	7	0·09	,,	0·115	2
,, ,, ,,	23	0·09	,,	0·39	23
2·0 unit Tr. fully loaded ...	10	1·0	,,	1·04	1,650
3·0 unit Tr. for 100 V_1 to 1,000 V_2	0	1·0	,,	0·054	0·4
Two identical Tr. used to	10	1·0	,,	1·85	—
step up volts from V_1 to	20	,,	,,	3·4	—
V_2, and down from V_2 to	30	,,	,,	4·7	—
V_3; the value of θ found	40	,,	,,	5·3	—
between V_1 and V_3 being	50	,,	,,	5·8	—
halved. Normal full load	24·8	0·09	,,	1·08	1,770
30 A	25·4	,,	,,	0·18	5
,, ,, ,,	27·0	,,	,,	1·00	1,540
,, ,, ,,	40	low	,,	4·3	—
,, ,, ,,	50	,,	,,	4·2	—
10 A current Tr. for oscillograph	10	—	A_1, A_2	0·088	1·2
,, ,, ,,	7	—	,,	0·144	3·1
5 A current Tr. as supplied commercially for wattmeter	5·7	—	,,	2·32	—

difference for inductive loads than for non-inductive, and it is noteworthy that a very sharply-defined minimum value of θ of 0·18° occurs at about 80 per cent. of the full load current, with a secondary circuit of power-factor 0·09. The small 10-ampere transformer was supplied by the British Thomson-Houston Co., to reduce current in the ratio of 20 to 1, for any secondary resistance not absorbing more than 2 volts, or 0·5 ampere. The phase difference between the primary and secondary currents at full load is less than one-tenth of a degree. The 5-ampere current transformer was supplied by a firm of the highest standing for use with one of their own wattmeters. The large phase difference found of 2·3° would seem to imply great error in use, yet on fully considering all the conditions of the instrument, I find that the error in reading works out to be only 1·7 millimetres on the scale, even when the full currents (*i.e.*, such as to produce full deflection on a non-inductive circuit) are flowing in the coils, and the power-factor of the load tested is the lowest for which the instrument is guaranteed—viz., 0·6. For smaller load currents this error is proportionately diminished, and it disappears altogether on high power-factor circuits.

My object in bringing these numbers before you is to afford evidence for my belief that wattmeters and other alternating-current instruments should be designed on the lines of the permanent magnet moving-coil instrument, and that well considered efforts in this direction will command success.

The object in view is no small one when we consider how much electrical advance, which has all been based on exact measurement, really owes to the introduction of sensitive galvanometers and voltmeters for direct currents; and that, in all probability, similar instruments for alternating currents will lead to important developments also. It is only fitting for us to remember how greatly this has been dependent upon the work of one man. At a time before most men now living were born, Sir W. Thomson applied for the first time to the structure of instruments skilful

engineering design. He altogether revolutionised them, and brought them to such a state of perfection that, except in comparatively small details, they have not been improved upon since. We are all glad that Lord Kelvin has been able, not only to take a great leading part in, but also to watch the *whole* of, this progress, and that we can still congratulate him on possessing the enthusiasm and mental activity of younger men.

RUNNING POWERS.*

By STEPHEN SELLON, Assoc.M.Inst.C.E.

"Whereas the construction of the Tramways, which are hereinafter described, will be of Public and Local advantage."

The above words, or their equivalent, will be found in the preamble of many Tramway Acts; they are, therefore, the ostensible primary justification for the granting of powers for legalising tramway construction. Having obtained powers, the tramway undertaker's obligations do not cease on construction, but continue during working, and the maintenance of his monopoly depends on the manner in which he fulfils his duties.

The road authorities have no right over the roads they maintain, superior to those of the traveller from the more distant county or foreign lands. They have duties in respect to the roads; mainly to keep them open, safe, and unobstructed to all comers; they have certain legal powers given them to enable them to perform those duties and to meet the consequent expenses, but proprietary rights or powers to obstruct, tax, or detain the traveller are not in their possession.

They are obliged to afford all travellers the maximum facilities within their power; and Parliament is entirely justified in ensuring that "the public and local advantages" which the tramways authorised can afford shall not be limited by unreasonable conduct on the part of the undertakers, whether due to sentimental, selfish, or capricious motives.

It has been my lot during the last two sessions of Parliament to hear many objections raised against running powers. It is difficult to treat any of them seriously; and it is, therefore, not surprising that the learned counsel, obtaining no solid grounds for rejection from the mouths of his witnesses, found himself forced to claim the application as unprecedented.

The only other objection urged, is founded altogether upon ignorance of what "running powers" really mean. Again and again the objection has been raised that the running company is desirous of usurping the rights of the owners of the tramways, and confiscating to itself the management of the tramways run over; an idea, which if it were not founded on gross ignorance, would be worthy only of the maddest inhabitant of Bedlam.

Obviously the lack of a precedent or objections of the character indicated do not condemn a proposal, but as so much importance is attached to it, and there is some interest and guidance to be obtained from the history of running powers, I will just go over the matter briefly.

It is not generally known that railways were originally intended as highways for accommodating the engines and carriages for the conveyance of passengers and goods by other companies or persons; and that this principle applied with equal force to railways or tramways constructed along a public road.

By the enactment of the Railway and Canal Traffic Act, 1854, Parliament obliged all companies whose lines junctioned to provide for through bookings, through goods rates, and to permit the through running of carriages, wagons, and trucks. The arrangements between companies, generally known as "running powers," differ from "facilities" in that they permit a railway company to run over the lines and use the stations of another with its own engines and servants.

There are abundant examples of running powers by agreement between railways, sometimes one sided, sometimes mutual, and there are a number of cases where Parliament has granted running powers by compulsion. In the latter case Parliament appears to have acted upon principles which may be classified generally under the following heads:—

To save the running company useless expenditure in duplicating lines or terminal accommodation.

To meet an obvious public convenience which could not be left at the mercy of the possible unreasonableness of the company in possession.

To remove the obstruction wilfully offered by a company to the traffic of another company, or where a company has failed to afford proper facilities.

As a statutory confirmation of an agreement entered into between two companies, so that the public advantages so gained should not be at the mercy of future quarrels or divergence of interests between the contracting companies.

In such cases the principle seems to have been conceded that the running company should take no profit on fares earned on the owning company's lines. It pays its own train expenses, and very frequently some charge by the owning company for terminal services and facilities.

There are a few exceptions to this rule of no profits.

It can, therefore, be stated that the principles regulating running powers are fairly established in most cases in railway legislation and traffic.

There is not the slightest reason why similar principles should not be applied to tramways; there are abundant examples of running powers by agreement, mutual running powers, and compulsory running powers as between tramways, and while "facilities" generally meet railway conditions, those of tramway traffic make facilities wholly impracticable for the attainment of the much-desired public advantage.

The earliest case of running powers that I am able to find as regards tramways was in 1874, when the Swansea Tramway Co obtained compulsory running powers over the Mumbles Railway.

[The author here gave 21 instances of running powers obtained within the last 12 years.]

The advantages of running powers, which enable two or more systems to be linked up and worked without any change of car, are so obvious, both on the grounds of public convenience and of financial benefit to the owners, that it is difficult to understand the existence of opposition.

I have made many observations on the effect of a break of service on the traffic of tramway systems. In every case the effect of a break is to reduce the earning capacity on the routes immediately affected, from 15 to 50 *per cent.*, whilst there is frequently a much wider spreading of the effect than could be anticipated, and any gain on alternative routes between the same points is far less than the direct loss. Conversely, directly the connection is re-established, the traffic returns to the normal conditions. The favourable effect of a "through" connection established between two systems previously worked with a break of service confirms these cases. As an illustration, I may instance the well-known Newcastle and Tyneside case. By the courtesy of Mr. McLellan, I am able to quote figures obtained from his statistics of traffic.

The Newcastle tramways terminate in open country about half a mile from Wallsend. The Tyneside company's line runs up to the same point through Wallsend from North Shields. During the month of April, 1904, when a change of car was necessary to enable passengers to get from the Corporation's system to the company's system, or *vice versâ*, Newcastle brought 48,795 passengers up to the terminus, out of which the company carried on 11,414, leaving 37,382 passengers on the road. Now, from the nature of the country, practically the whole of that number must have been bound for Wallsend, and preferred to walk the half-mile stage instead of mounting another car. During the month of September both the Corporation's and the company's cars ran through, and 48,499 passengers arrived from Newcastle at the point mentioned, 36,395 of whom went on to Wallsend, thereby reducing the figure of 37,382 passengers walking on to 12,104; and, mark you, this result was obtained immediately upon the through service being run. Similarly, travelling towards Newcastle in April, 16,070 passengers only were carried to the termination of the company's tramways, whereas in September, 29,930 availed themselves of the through cars on this stage. Mr. McLellan further informs me that the through service has undoubtedly generally stimulated the tramway traffic.

In considering these figures it must be borne in mind that the month of April took in the Easter holiday traffic, and that between April and September the electrified service on the North-Eastern Railway came into operation. [Other instances were also given.]

I therefore take it that running powers between adjoining tramways are necessary for the full accomplishment of their public purpose, and, incidentally, for the best commercial results to the undertakers; and submit that any tramway undertaker, whether municipal or company, who stands in the way of such conveniences, is abusing his position in just the same way as would a road authority who built walls or dug ditches across the roads at its boundaries, in order to compel every passenger to climb over or splash through them as the penalty for intruding on "our roads" or leaving the "sacred territory."

The justification of compulsory running powers is, of course, the public necessity. It ought not to be tolerated, that parties entrusted by Parliament with tramway powers should be permitted by unreasonable conduct, to prevent or hinder the full public use and advantage of any means of connection.

The only objection worthy of discussion is that of the full occupation of the city tramways by the local traffic. If this is a fact, it shows that further tramway facilities are necessary, say, for example, by the construction of lines more or less parallel to the through routes, and I would submit that, given the maximum possible number of cars on the city lines, there will be a balance of advantage in having some of them running through, to and from the suburban districts, even though some short-distance or local passengers are displaced by long-distance or through passengers.

It has been already stated that running powers on a railway do not mean profit to the running company. In case of mutual running powers on two systems of tramways this practice should, I think, still prevail; but in cases where there is no mutuality in running powers it is a very different proposition. Glasgow, by obtaining a through service into the centre of Paisley, with a population of 120,000, instead of having to stop at the boundary, is fructifying some miles of barren line to the detriment of the Paisley company; whereas, if Glasgow and Paisley had mutual powers, this one-sided advantage would not exist.

It is clear that in all cases where an outside company desires to gain admittance to the centre of another tramway system, it is proper that the local service should not be interrupted, and that, in adjusting terms and conditions, if running powers are granted into the centre of the existing system, the effect of the break at the centre ought to be taken into account as a set off against any advantage the owing company may be said to secure in extra traffic by the connection.

* Abstract of Paper read before the Tramways and Light Railways Association, on December 1st, 1904.

Having regard to the importance to the public of the advantages I have endeavoured to indicate, which experience shows cannot but result from the working of tramways connecting important districts as a through service free from obstruction, I venture to suggest that this Association will perform a most useful function by making every endeavour to remove the many prevailing and unfounded misapprehensions which exist, by the dissemination of information bearing upon the subject, and so abolish what, I think, must be conceded to be a most mischievous obstruction to the better and more useful developments of interconnection by means of through traffic.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

25,235. "Improvements in ignition plugs." J. T. Taylor and W. Lawson. November 21st.

25,243. "Improvements in or relating to the 'party line' system of telephones." H. B. Stocks. November 21st.

25,248. "Improvements in or in connection with electric ignition apparatus for internal combustion engines." W. C. Priestley and B. Holroyd. November 21st.

25,249. "Improvements in electric switches for the ignition circuits of multiple cylinder explosion motors." E. Talbot and D. Mondey. November 21st.

25,265. "Improvements in or relating to the manufacture of storage battery or accumulator electrodes." A. J. Boult. (Accumulatoren und Elektricitätswerke Act. Ges. vormals, W. A. Boese & Co., Germany.) November 21st.

25,276. "Improvements in vapour electric lamps, rectifiers and the like." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) November 21st.

25,282. "Improved electrode for apparatus producing radiant electrical energy." Siemens & Halske, Akt. Ges. November 21st. (Date applied for under Patents Act, 1901, November 24th, 1903, being date of application in Germany.) (Complete.)

25,329. "Improvements in electrical measuring instruments." W. C. Fisher. November 22nd.

25,331. "Improvements in treating the contents of electrolytic cells." J. Hargreaves. November 22nd.

25,370. "Improvements in telephony." J. H. Lee and A. E. R. Bottone. November 22nd.

25,376. "Improvements in or relating to electric batteries." H. Csanyi, E. Klupathy, and G. von Barczay. November 22nd.

25,378. "Improvements relating to electric air-gap condensers for use with high-frequency currents." H. H. Lake. (The Electro-Radiation Co, United States.) November 22nd.

25,382. "Improvements relating to rotary spark-gap apparatus for use with high-frequency currents." H. H. Lake. (The Electro-Radiation Co., United States.) November 22nd.

25,386. "Improvements in single-phase commutation motors." T. von Zweigbergk. November 22nd.

25,406. "Improved method of amplifying variations of energy in electric circuits." P. C. Hewitt. November 22nd.

25,458. "Improvements in electro-magnetic circuit-breakers." Veritys, Ltd., and A. E. Gott. November 23rd.

25,463. "Improvements in and connected with brush-holders for dynamo-electric machines and electric motors." E. S. W. Moore and S. Bourne. November 23rd.

25,478. "Improved detachable service fuse-box, single and double pole." W. H. James. November 23rd.

25,492. "Trolley for electric cars." L. M. McBride. November 23rd.

25,498. "Improvements in the construction and attachment of gear wheels for electric and similar high-speed cars." A. Wiseman. November 23rd.

25,504. "Oscillating magneto sparking plug." R. H. Derry. November 23rd.

25,519. "Improvements in electric incandescent candle lamps." F. C. Daffern. November 23rd. (Complete.)

25,524. "Improvements in electric lighting of railway carriages and the like." O. Imray. (J. Denham, Cape Town.) November 23rd.

25,592. "Improvements in electric switches." C. E. Hunter. November 24th. (Complete.)

25,608. "Improvement in Hertzian-wave projecting and receiving apparatus for locating the position of distant metal objects." C. Hulsmeyer. November 24th. (Complete.)

25,610. "Improvements in or relating to wireless telegraphy." F. W. Howorth. (G. O. Squier, United States.) November 24th.

25,618. "Improvements in trolley wheels for use on electric railways." H. J. Haddan. (S. W. Bates, United States.) November 24th.

25,620. "Improvements in apparatus for controlling or/and supplying current for power and light on consumers' premises during certain periods." A. M. Taylor. November 24th.

25,625. "Means for facilitating the control of accumulator cells." H. Leitner. November 24th.

25,630. "Improvements in and relating to systems of control for electrically-operated doors." The British Thomson-Houston Co., Ltd. (The General Electric Co, United States.) November 24th.

25,631. "Improvements in electric circuit breakers." The British Thomson-Houston Co., Ltd. (The General Electric Co, United States.) November 24th.

25,632. "Improvements in and relating to electric meters." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) November 24th.

25,633 "Improvements in reverse current relays." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) November 24th.

25,635. "Improvements in attachments for trolley poles." The British Thomson-Houston Co, Ltd. (The General Electric Co., United States.) November 24th.

25,636. "Improvements in and relating to electric power transmitting mechanism." The British Thomson-Houston Co., Ltd. (H. S. Meyer and B. Hopps.) November 24th.

25,637. "Improvements in or connected with space telegraphy." J. S. Stone. November 24th. (Date applied for under Patents Act, 1901, November 24th, 1903, being date of application in United States.) (Complete.)

25,638. "Improvements in or connected with space telegraphy." J. S. Stone. November 24th. (Date applied for under Patents Act, 1901, November 24th, 1903, being date of application in United States.) (Complete.)

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25,647. "Improvements in or connected with space telegraphy." J. S. Stone. (Date applied for under Patents Act, 1901, November 25th, 1903, being date of application in United States.) November 24th. (Complete.)

25,648. "Improved electric glow lamp, with combined reflector or shade." W. B. Spurrier. November 25th.

25,682. "Improvements in arc lighting lamps." L. S. Anderson. (Date applied for under Patents Act, 1901, November 30th, 1903, being date of application in Sweden.) November 25th. (Complete.)

25,693 "Improvements relating to insulated chairs for carrying electric current conducting rails." W. Way. November 25th.

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25,730. "Improvements in dynamo-electric machines." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) November 25th.

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